THE

ELECTRICAL REVIEW.

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THE

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CHARGES FOR ELECTRICAL ENERGY.

ALTHOUGH a very great deal has been written on the subject of charging for or the price of electrical energy, there is still room for any writer who can put in succinct and clear language the points which most seriously affect the question. Mr. Arthur Wright has gone into the whole matter exhaustively and technically, but it does good to have his arguments boiled down and presented to the general technical public in a readily-understood fashion, and with perhaps a little more of the lighter part of the subject uppermost. Readers of *Cassier's Magazine* are, we should say, intelligent people, but not necessarily always skilled station men, and for this reason the article by Mr. Alton D. Adams, appearing in November issue under a heading identical with this, should do good.

Many English station engineers are asking one another the question, Does the demand indicator in practice assist the revenue, and the business as a whole, as much as the theoretical considerations argue it ought to do? To this a negative reply has often to be given. We are very far from doubting that it has been a most useful appliance and served the industry well, and that Mr. Wright, the Reason Company, Mr. W. L. Madgen, and others, have logic on their side when they apply the Hopkinson principle to concrete cases. Alas! however, the ordinary shopkeeper is not a logical individual, and members of committees are often deeper cut by the complaints of their friends than they are affected by the serious and weighty arguments of the engineer. What we mean is this. The Brighton scale is *the* logical one, and has worked out well, because it has been applied in its entirety by Mr. Wright. In other places, however, the initial charge is really too low (6d. first hour, and 3d. after, say), and this robs the demand principle of its most important feature. Again, in Edinburgh the huge success of the municipal supply has been attained on a uniform charge reduced as quickly as possible. Glasgow, e believe, used, and has discarded, or is discarding, the demand indicator. Many of the companies manage to do without it, and they, above all, are keenly interested in financial results. The cost of indicators for small consumers and the trouble of testing and resetting also enter into the question, while the admitted secular change in the glass bulb makes it necessary to recalibrate the instruments after being first brought into use. The feeling we allude to has been strongly shown at Croydon and Hanley amongst other places. Now, in this country, public opinion is the one important and unassailable thing that engineers have to yield to in the long run, and if public opinion tends to become too strong for any one method of charging, either that method must go or the public must be educated.

"Among the fixed expenses of a plant are the interest on invested capital, salaries, rents, sinking fund and depreciation. After the plant has been operated during a sufficient number

of hours each day to cover these fixed expenses, any further earnings are clear profits, except for the small costs of fuel, water, and incidental items . . . . If a fixed charge per unit of energy be made to every consumer whose monthly or yearly supply is the same in amount, it is evident that the rate of profit to the station will vary materially for different customers . . . . Under the older system of uniform rates to customers of equal monthly consumption, the electric stations actually lost money on those customers whose maximum demand continued for only one hour or less daily." Thus argues Mr. Adams, and it is only a pity that the individual consumer and consumers as a class cannot be made to understand that in the long run they must benefit by the demand scale. Expediency has, however, often to take the place of logic and technical soundness, and there is no doubt that a feeling is growing that the immediate benefit of supply to influential tradesmen and householders is lost owing to the initial price. Those who talk most and loudest are sometimes given an attentive ear, and a policy of playing for public approbation — which, by-the-bye, is encouraged to a considerable extent in Corporation work— may lead to a reversion in more than one quarter to uniform price. We regret the cause, but it remains to be seen whether officials are strong enough to carry their views in face of interested opposition. There is, after all, something to be said for the short-hour consumer, and it may be that as municipal ventures at least are not even now run on purely business lines, and do not claim to be profit-earning concerns, the greatest benefit to the greatest number may, in certain districts, be held to require a lowering of the initial price or a resumption of a uniform rate, notwithstanding the soundness of all the arguments directed against such a policy.

Electrolysis and Earth Returns.

In moving the adoption of the report of the Chelsea Waterworks Company last week, the chairman remarked that part of the increased expenditure was due to the cost of opposing an electric tramway Bill in Parliament; the object of this and other water companies being to put the cost of repairs necessitated by electrolytic corrosion on the electric tramway undertakers. Now, to the best of our belief, although some electric tramways have been in operation for several years in this country, in no single instance has any such damage been observed, although in the United States excessive corrosion has undoubtedly taken place at times. The cause of the difference is not far to seek. In America, it has been a common practice to allow a considerable drop of pressure in the rail return, shunting a correspondingly large amount of current into the earth and the water and gas mains embedded therein; for example, at Brooklyn, as much as 40 volts fall of pressure in the line is not unknown, and 20 or 25 volts is common. But, fortunately, in this country, a very strict limit is placed upon the drop by the Board of Trade, and great care has been exercised by the engineers to prevent even this limit from being approached, except under particularly unfavourable circumstances. Moreover, not only are tramway engineers prepared to accept a compulsory limit far below the seven volts prescribed by the Board of Trade, but in some cases they have voluntarily succeeded in confining the drop to less than half that specified. Under these circumstances the risk of injury to iron pipes laid in the neighbourhood of the tramway becomes a mere sentiment. It must not be forgotten that the resistance of the joints in water and gas mains is very high, so that a pipe line is not by any means the good conductor that it might be supposed to be; actual tests show 80 or 90 per cent. of the total resistance of such to reside in the joints. In the experiments of M. G. Claude, to which we referred last week, the currents flowing in pipes were found to be but 2 to 5 per cent. of the total current straying from the rails, which again was only 12 to 30 per cent. of the total return current; from this it follows that only about ½ per cent. of the whole current returns by way of the pipes along a tramway route. Thus, on a section of track five miles long, with a five minutes' service, the current flowing along water pipes parallelling the route would be of the order 1 ampere!—a perfectly harmless rate. Where, however, the pipes near the power house are connected by means of cables with the negative bus bar, with the mistaken notion that by this means the electrolytic troubles can be reduced, the current flowing in the pipes is much increased; and, as M. Claude points out, in common with other able writers on this subject, the result is corrosion of the pipes at the joints, each of which compels the current to leave and return to the pipes. It is important, therefore, that the pipes should *not* be connected with the negative bus bar; and, if the water companies but knew it, their best course is to oppose this procedure, instead of opposing the tramways *in toto*. The remarkable fact that the earth-conduction is so largely of a metallic nature, first definitely proved, we believe, by M. Claude, has a most important bearing on the limit of pressure-drop; so long as this is small, but little electrolysis can take place; but if it be fairly large, the electrolytic conduction becomes the predominant factor, and trouble begins, as we know has been the case in America. In justice, traction engineers must admit that in this instance the maternal regulations of the Board of Trade have had the happiest results.

Electric Canal Haulage.

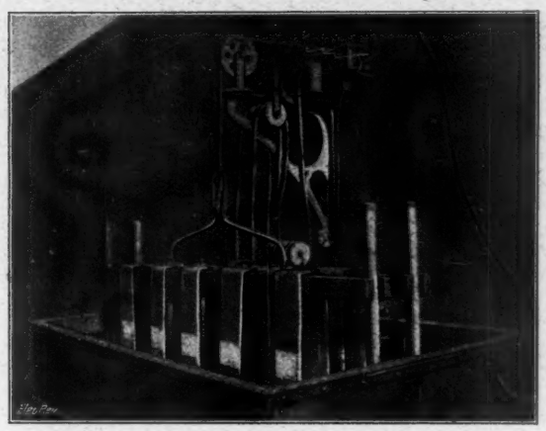
A most timely proposition was recently laid before the Board of Trade by a deputation from the Associated Chambers of Commerce—namely, that a Royal Commission should be appointed to inquire into the canal system of this country. The deputation pointed out the serious disadvantage at which our industries are placed by the difficulty and costliness of internal communication, whereas on the Continent the canal system of transport has been developed to a high pitch of efficiency, thanks largely to the assistance rendered by the respective governments. Enlargement of the locks and uniformity of gauge are urgently needed; when these objects are attained, it will be possible, as a member of the deputation observed, to make efficient use of steam or electrical haulage. In his reply, Mr. Gerald Balfour drew attention to the steps which had already been taken by Parliament to improve the position of the water traffic in this country, and to prevent the railway companies from throttling the industry. Mr. Balfour recommended that the Chambers of Commerce should appoint a committee to draw up a scheme, rather than that a Royal Commission should be appointed. Whatever course be taken, we trust that no time will be lost. We have from time to time referred to the subject and pointed out its extreme importance in relation to the general well-being of the manufacturing industries of Great Britain, and of the electrical industry in particular. France, Germany and Belgium are, and have been for some years, actively conducting experiments on a large scale with a view to the employment of electricity for haulage; witness the Galliot motor-tricycle system on the Burgundy canal, each tractor, of two tons weight, hauling a load of 700 tons: the Lamb and Köttgen systems on the Finow canal; and the Gérard system on the Brussels-Charleroi canal, 50 miles in length. The last mentioned appears to be a thoroughly practical scheme, operated by high pressure three-phase currents transmitted from a central power station; four-wheeled tractors, each of two tons weight, run on the towpath and haul trains of five boats, each laden with 10 tons, at 2½ miles per hour, while the villages and factories on the line of the canal are supplied with light and power from the same system. At home, the only proposition of any importance that has been put forward as yet appears to be that of Messrs. Thwaite & Cawley, and even this has not up to the present been put to a practical test. Nevertheless, as we have said before, the adoption of electric haulage on canals is inevitable in the long run; and to overlook the enormous field which it constitutes for manufacturers of electrical machinery would be an error almost as grave as that committed in respect of the tramways. Further, we are in almost as good a position to carry out such work as our foreign competitors, who have not—*as yet*—attained the great lead which they gained in the latter case. Once more, we earnestly entreat electrical manufacturers to interest themselves in this most important and pressing question.

WATER LOADS FOR ELECTRICITY WORKS.

By W. E. WARRILOW.

In the early days of electric lighting, when small units were commonly employed, the reliability of the plant was generally accepted, after its preliminary trials by the builders and at the works on its own foundations. After settling down to regular running, the few repairs necessary were effected, and the plant was again given its usual work without testing on an artificial load, though no doubt it would be run round "light" for a short time. Apart from this, no other test would be applied, the machine being "chanced" on the lights when it was considered in a fit condition to take up regular running. This may seem a risky course to pursue, but the particular circumstances would merit it. The size of the unit was conducive to general satisfactory running, and when breakdowns did occur the spare set could be got up to speed almost immediately, so that the lights would hardly be out. Consequently, when all things are considered, the engineer was almost justified in putting his machinery, which had been repaired, on the mains without previous load tests.

The growth of the electrical industry, however, has changed the whole aspect of affairs, so much so that the altered conditions bring in their train difficulties which must be met and overcome. Experience has shown that small units are no longer economical when repeated in great numbers to meet the increasing demand, consequently the size of generating units has of recent years been going up by leaps and bounds. Whether the limits have been yet reached it is impossible, of course, to say, but it is nevertheless true that units ranging from 500 to 1,500 KW. are being laid down yearly. The concentration of so much power in one unit is a serious matter, as such a number of lights are dependent on the satisfactory running of one machine, and the consequences of breakdown are by no means pleasant for the consumer. Extra precautions are therefore necessary to ensure the reliable running of the plant when such dire results are attendant on its failure. The size of the unit, moreover, brings with it certain unavoidable features. It cannot be got up to speed at a moment's notice, the engine taking perhaps four or five minutes to attain its normal



Water Resistance on Roof of Boiler House.

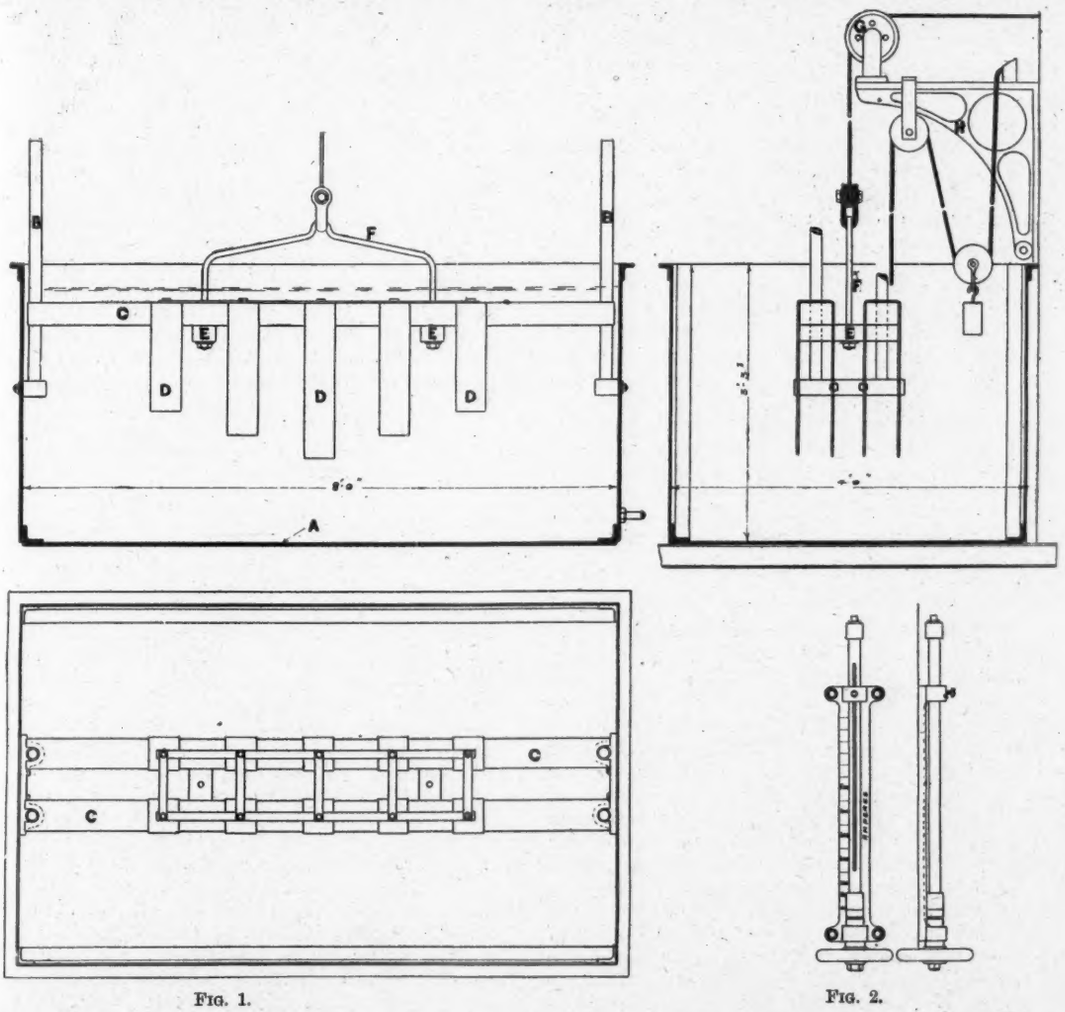


Fig. 1.

Fig. 2.

number of revolutions, and where it has been necessary to shut another plant down on account of sudden mechanical or electrical failure, every moment is precious. When machines are running in parallel the withdrawal of the faulty unit may necessitate the opening of a circuit if the remaining sets cannot maintain the normal voltage, and on this occasion the tardiness of the large unit in attaining synchronism will be painfully evident.

The maintenance of large electric light engines in thorough repair is no small matter, and one from which the element of chance should be almost, if not entirely, absent. Repairs to brasses and reciprocating parts generally should be followed by tests which can leave no doubt in the mind of the engineer as to the fitness of the plant to resume its regular work. Allowance can, of course, be made for unforeseen circumstances, but every opportunity should be taken of those means which can make "assurance doubly sure." The tests referred to are of the electrical order, and are carried out on an adjustable load provided for the dynamo. This usually takes the shape of a water resistance, which, though well known, is seldom erected as a permanency on the works. When new generating sets are put down, the trials are run on resistances of a temporary nature provided by the contractor for the plant, and removed by him at the conclusion of the trials.

There are, of course, several firms who can supply an artificial load to deal with machines of any capacity, but their prices are prohibitive. It is, however, possible to manufacture the apparatus at the works, and the following lines describe a "home made" resistance constructed at small cost. No novelty is claimed for its principle, though its utility and satisfactory working may sanction its description.

The accompanying photos and diagrams will give a general idea of the construction and position of the apparatus. The resistance of water is made use of by suspending lead plates, connected to one pole of the circuit, in the water, while the other pole (or conductor) is connected to the tank, containing the water.

Referring to the diagram appearing on the preceding page, the tank, A, containing the water is fitted with inlet close to the bottom, and overflow may be allowed to pass over the top of the tank; B B are wrought-iron pipes screwed into castings bolted to the inside ends of the tank, and these pipes act as guides to the beams, C C, which are fitted with a number of lead plates or strips, D D, bent to drop over and rest on the beams. The two beams are held apart by distance pieces, E E, having holes drilled in them for the reception of the supporting iron F, this latter being shaped with a loop for the raising and lowering wire. The wire is not fastened direct to the iron, but round a bolt passing through a thong of leather laminations. This serves the double purpose of providing a flexible support to the beams and insulating the wire from currents which may lead to the rod. The wire passes over the pulley, G, fixed to the bracket, H, which is firmly bolted to the wall. A hole in the wall admits of the passage of the wire into the engine room, where it is brought over pulleys (suitably placed) to the raising and lowering screw, shown by fig. 2. The adjustment is carried out by means of a large wooden handle, which is free to turn in a recess in the wall cut for the purpose. The wire is fastened to the end of a pipe in which the screw works, the pipe being prevented from turning by a screw which projects into a slot cut in the pipe. A small pointer fastened to the lower end of the pipe makes the adjustment to exact requirements an easy matter, a scale marked out in amperes or kilowatts being painted on the base of the arrangement. When the adjusting screw can be placed quite close to the switch gear the scale is not necessary, as adjustments can be made with a minimum of trouble, but where the screw is more easily placed on the opposite side of the engine room to the switchboard the convenience of the scale will become evident. The dimensions of the tank are given in the diagram, so that other parts will appear in proportion, but in the construction of another such arrangement the particular circumstances will call for slight alteration.

The arrangement in question, which has recently been erected in a large alternating current station in the Midlands, is fixed on the roof of the boiler house, the supports for the tank being fixed in the engine house wall. The position is an excellent one, as complete isolation during working is easily effected, and the overflow from the tank is carried away without expensive piping arrangements, the rain-water spouting doing all that is necessary. Extra precautions are needed to ensure the confinement of high pressure currents, but these present no difficulties which cannot be surmounted. The flexible cables carrying current to the moving lead plates require the greatest amount of care, though a satisfactory arrangement of these is no hard matter. The photograph will make clear the disposition of the joint box and cables. Suffice it to say, that the main from the switchboard is a concentric lead-covered one, and the box is arranged with fittings for bifurcating.

The load tests carried out on the resistance prove its capabilities very well. A 600-KW. alternator has been run at full load quite successfully on the tank without any boiling of the water, the circulation being maintained through the test. The lead plates in this case were only one-quarter immersed, so that when the distance to be traversed is considered, 1,800 KW. may be successfully dealt with by the tank. The arrangement has not been tested for arcing through the water or across the atmosphere moistened by the steam from the water, but as no signs of such occurrences have yet become evident, their possibilities may be left undiscussed. At the same time, every precaution for insulation has been taken.

The distance between the lead plates and the tank sides is the same all round, the load adjustment being effected by reduction of the distance between the plates and the tank bottom. Should the wire or leather thong break, the plates could not reach the bottom of the tank by reason of the stops afforded by the brackets supporting the guide tubes. The above devices seem to make every allowance for apparent possibilities of accident, so that omitting the unforeseen, the arrangement should work satisfactorily for all time.

The chief item of expense is the tank, which will cost about £20, and the other items, excluding the cable from the switch gear, will bring the price up to £30 or £35, a figure which will compare very favourably with the prices quoted by manufacturers. The cost of the cable, which should be of the best (the use of old material is never to be commended), will vary with the distance between tank and switch gear, but £45 to £50 will be an average figure.

All things considered, then, there is no reason why large units should be run with any doubt as to their reliability after repair, as at small cost a satisfactory testing arrangement can be erected which will well repay the time and money expended on it.

A THIRD RAIL RAILWAY.

At this time, when English engineers are discussing and taking more than usual interest in the question of electric railways, a brief account of an important development in American railway practice will be opportune. The Albany and Hudson Electric Railway—a long third rail line, 37 miles in length, connecting the towns of Albany and Hudson—was on November 22nd, 1900, formally opened. This line is particularly interesting from the fact that it is an example of high pressure transmission, and that it may be looked upon as the first example, on a commercial scale, in which the third rail replaces the overhead trolley on an electric railway.

The generating station is situated at Stuyvesant Falls, on the Kinderhook Creek, about 10 miles north of the Hudson terminus. These falls have a 105-ft. drop, from which at least 2,500 H.P. is available, and the water is brought to the power house by two parallel steel pipes, each 7 ft. 6 in. in diameter. The electric plant consists of 10 generators, supplied by the General Electric Company, of America, and each machine is coupled direct to a horizontal shaft turbine, made by Stilwell-Bierce & Smith-Vaile, of Dayton, Ohio. The regulation of the turbines is effected by Lombard governors. We may here note that in case of a sudden stoppage the turbines are automatically relieved of the abnormal pressure which would result, by means of two vertical pipes, 10 feet higher than the falls, *i.e.*, 115 feet high.

The generators for the railway section consist of three

750-kw. three-phase 12,000-volt 60-cycle machines, but as the company supply current for lighting and other purposes, both at Hudson and at Rensselaer (near Albany), there are also two 250-kw. and one 125-kw. 2,200-volt single-phase generators for lighting and power work. The supply for Hudson is transformed up to 11,000 volts, whilst that for Rensselaer (which is 23 miles from the power house) is transmitted at 22,000 volts. There are also two multipolar 200-kw. 600-volt direct-current dynamos which supply the portion of the load nearest the power house. The exciters are 40-kw. 60-volt machines.

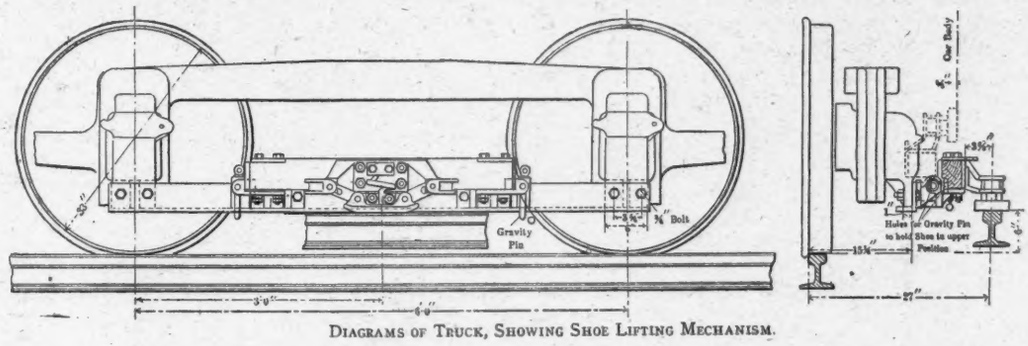
To avoid the serious and prolonged interruption to the service, which would be occasioned by the failure of the water supply in consequence of ice, or in times of drought, there is in addition to the above water-power equipment, a separate boiler plant and two vertical Buckeye cross-compound engines, so arranged that one of the 750-kw. three-phasers and the two 250-kw. single-phase machines may be driven by them.

As already indicated, the energy required for the railway section is transmitted by three-phase currents at 12,000 volts, and these currents are taken by overhead wires, supported by substantial poles with porcelain insulators, to three sub-stations. The company possesses the right of way of the track, which is wire-fenced the whole length, and the poles are placed along the track. The overhead wires, it may be noticed, are transmission, and not feeder lines. One of the sub-stations is 8 miles to the south of the power-house, on the outskirts of Hudson, and two are situated to the north of the power-house, one at North Chatham, 11 miles away, and the other at East Greenbush, 23 miles distant, and about 4 miles from Albany. At each of these sub-stations, the current at 12,000 volts is transformed down to 380 volts by means of air-blast transformers, from which it is taken to rotaries, which deliver current to the line at 600 volts. Inasmuch as the third rail acts as feeder and contact conductor, there is obviously no need of a supplementary 600-volt feeding network.

The particulars of the track and contact shoes, as given by the *Electrical World and Engineer*, December 8th, 1900, are as follows :—"The track, which is both single and double, as required at various points, is heavily ballasted, and has been so laid out as to minimise grades, none exceeding 5 per cent. It is laid with 80-lb. **T**-rail, placed upon 6 inches by 8 inches by 8 inches chestnut ties, 24 inches between centres. The track is heavily ballasted and compares in every respect—to advantage—with standard steam road work. The third rail is raised 6 inches above the track, and is supported on the end of every fifth sleeper, or every 10 feet, by wooden blocks. Over these blocks are fitted malleable cast-iron caps, or chairs, upon which the rail rests. They are so made as to protect the wooden block from moisture and help to maintain a high degree of insulation. The third rail is not quite so high in carbon as the track rails, and thus has a superior conductivity. The track itself is bonded and cross-bonded for return.

"Contact with the third rail is made by shoes, of which each car carries four, or two on each side. These shoes are 31 feet apart, so that the 'toe' of the car has made forward contact before the 'heel' has let go in the rear. At all farms and highway crossings the third rail is interrupted, and the circuit is maintained by cable carried under the roadway, so that while the car can make the straddle and keep in touch with its source of supply, the foot passenger or horse going over is exposed to no peril. Where breaks of this kind occur, the adjacent ends of the third rail are depressed, so that the shoe re-engages easily without any blow and slides smoothly into working position. The shoe is let up and down, swivel fashion, and is held up by a pin when not in use. The conductor lets it down or puts it up as needed. At the terminals or in the yards the cars use a trolley in the ordinary manner, and each car carries a commutating controller to throw current from the underneath contact to the overhead.

"The rolling stock equipment of the road comprises at present 18 passenger cars and two express cars, of Watson construction. The passenger cars are 53 feet long, and can seat 60 passengers. The summer cars have four G.E. 50-H.P. motors, and the winter cars four 75-H.P. motors, the former being capable of speeding up to 38 miles an hour, and the latter up to 51 miles, a rate that was more than maintained on the occasion of the recent trial trip. The wheels have a smaller flange than is usual for cars running on such lines, but this is due to the fact that they have to ply also on regular street car lines within city limits. Such cars as have been described are heavy, but the bridges and viaducts along the line have all been built or reinforced, so as to provide a superabundant factor of safety in this regard."



Diagrams of Truck, Showing Shoe Lifting Mechanism.

THE COMPANIES' ACT, 1900.

(*Concluded from page* 977.)

The Statutory Meeting.

The "statutory meeting," which has hitherto been held within four months of incorporation, must in future be held not less than one, nor more than three months, from that date. Hitherto little business of importance has been transacted at such meeting, but the new Act makes important changes in this respect.

At least seven days before the meeting a report must be drawn up by the directors and laid before the shareholders. This must state (*inter alia*) :—

(*a*) The total number of shares allotted, and the consideration other than cash ;

(*b*) the total amount of cash received by the company in respect of shares ;

(*c*) an abstract of receipts and payments on capital account, and of preliminary expenses ;

(*d*) Names, &c., of directors and officers ;

(*e*) The particulars of any contract required to be modified, and the particulars of the required modification.

Matters arising out of this report may be discussed at the meeting. The directors must provide a list showing the names, &c., of the members of the company and the number of shares held by them, such list to be open to inspection at the meeting. The meeting may adjourn from time to time, and resolutions of which notice has been previously given, may be passed at a subsequent meeting. Important consequences

E

may follow failure to hold such a meeting, or omission to prepare the necessary report. Thus in such a case it is competent for a shareholder to apply for a winding-up order, and upon hearing the petition the Court may either grant a winding-up order or declare that a meeting be held. Costs may be granted against persons who are responsible for the default.

III.

Requisition of a General Meeting.

Hitherto the question whether the shareholders can requisition the directors of a company to hold a meeting has depended upon the articles of association. After January 1st, 1901, however, this power may be exercised by shareholders, independently of any regulations to the contrary. Thus it is provided by Section 13 that shareholders representing one-tenth of the issued capital of a company may call upon the directors to convene a meeting. In case the directors refuse, the shareholders may themselves call the meeting within 21 days of the requisition. The requisition must be deposited at the registered office of the company.

Registration of Mortgages.

By the Companies' Act, 1862, it is provided that every company must keep a register of every charge or mortgage specifically affecting any property of the company. Such a register is open to the inspection of any creditor or shareholder, or his solicitor, at all reasonable times, free of charge. The Act of 1900, however, provides that every mortgage or charge created by a company after the commencement of the Act, shall in so far as the same is a security on the company's property be void against the liquidator and any creditor of the company, *unless filed with the Registrar within 21 days*. The register so kept is to be open to inspection by *any person* on payment of a fee. Thus any member of the public may inspect charges on the property of any company at Somerset House! The instruments which must be registered include (*a*) mortgages and charges for the purpose of securing any issue; (*b*) mortgages or charges on uncalled capital of the company; or (*c*) mortgages or charges created or evidenced by an instrument, if executed by an individual, would require registration as a bill of sale; or (*d*) a floating charge on the undertaking or property of the company. It seems that mortgages or charges on present or future book debts, debentures and charges which are not secured on any part of the property or undertaking of a company, and liens of daily occurrence, do not require registration. Further, a mortgage given in the ordinary way upon the freehold or leasehold property of the company will not require registration. Failure to register may expose companies, their directors, managers, and officers, to liability in a fine of £100.

It is important for every mortgagee or chargee to see to the registration, otherwise he may run the risk of being reduced to the rank of a simple contract creditor.

The Annual Summary.

The annual summary, with which all who are acquainted with Section 26 of the Companies' Act, 1862, will be familiar, must be framed so as to distinguish shares issued for cash from those issued for other consideration. It must also show—

(*a*) The amount due from the company under mortgages requiring registration.

(*b*) The names, &c., of the persons who are directors at the date of the summary.

Audit.

It is provided by Section 21 of the Act that every company shall, at each annual general meeting, appoint an auditor or auditors to hold office until the next annual general meeting. In default, the Board of Trade may appoint and fix the remuneration of an auditor on the application of any member. No director or officer is allowed to hold the office. Vacancies may be filled by the directors. The remuneration of an auditor is fixed at the general meeting. An auditor may have a right of access at all times to the books and accounts of the company, and is entitled to require from the directors and officers such information as may be necessary for the purpose of his duties, and the auditor must sign a certificate at the foot of the balance-sheet stating whether or not all his requirements have been complied with, and must make a report on the accounts and on the balance-sheet during his tenure of office, and in such report shall state whether the balance-sheet referred to is properly drawn up so as to exhibit a true and correct view of the company's affairs, as shown by its books. Such report must be read before the company in general meeting.

Repeals of Previous Enactments.

Perhaps the most important repeal effected by the new Act is Section 25 of the Companies' Act. That section provided that every share in any company shall be deemed and taken to have been issued, and to be held subject to the payment of the whole amount thereof in cash, unless the same shall have been otherwise determined by a contract duly made in writing, and filed with the Registrar of Joint Stock Companies at or before the issue of such shares. This section is now repealed, and no proceedings can be commenced under it after January 1st, 1901; but curiously enough an Act which was passed in 1898, to give relief under this section still remains upon the book, although in future it must, to a large extent, be a dead letter. We have already seen, however, that by Section 7 of the Companies' Act, 1900, [*Supra sub. tit.* Return of Allotments.] that directors, &c., are liable to heavy fines unless they file a list of [*inter alia*] all such contracts with the Registrar within one month after allotment. The object of Section 25 was to prevent contracts under which a man was to take shares and to pay for them by supplying goods when wanted; and in its practical application the section gave rise to considerable difficulty. With the repeal of the section, these difficulties are now removed. It will still be necessary, by virtue of this section, to file a contract in writing in the case of shares allotted in whole or in part for a consideration other than cash, but (1) the contract need not be filed at or before the issue: it may be filed within one month after the allotment; (2) failure to file the contract will not prejudice the allottee or result in the shares being treated as unpaid; it will merely render the affairs of the company liable to penalties.

Underwriting.

There is nothing to prevent a company arranging for the underwriting of its own capital, and paying a reasonable commission for so doing; in fact, this is declared to be legal in the new Act, if the shares are offered to the public for subscription, and the amount of the commission is authorised by the articles and disclosed in the prospectus, and the commission paid, or agreed to be paid, does not exceed the amount thus authorised. Such is the effect of Section 8, Sub-section (1) of the C.A., 1900. But unless the conditions are complied with, no company can apply any of its shares or capital money, either directly or indirectly, in payment of any commission, discount, or allowance to any person in consideration of his subscribing, or agreeing to subscribe, for any shares (see Sub-section (2)).

Section 10.—It is important to notice that this section only has reference to companies which offer shares for public subscription. It was proposed by Mr. McArthur, when the clause was discussed in committee, that its provisions should apply to private companies, so that a private company might be able to obtain the assistance of underwriters. This proposal, however, was negatived, the Attorney-General pointing out that although commission for underwriting was not legal, the payment of brokerage was. "The object of the Bill," said he, "is to leave underwriting to be done only in cases where the fullest publicity can be given."

Brokerage appears to have been held legal in Metropolitan Coal Consumers' Association *v.* Scrimgeour (1895) 2 Q.B. 604, where it was held that for the purpose of issuing its capital the payment of brokerage is *intra vires* of the company and unimpeachable where the services of a broker are reasonably necessary and the broker properly employed, and the commission of so much per share is a fair and just remuneration for the services rendered.

False Statements.

If any person in any "return, report certificate, balance-

sheet, *or other document*" required by or for the purposes of this Act wilfully and knowingly makes a false statement, he is guilty of a misdemeanour and punishable accordingly. [Section 28.] Doubts have already been raised as to whether a prospectus is brought within this section. In the absence of authority, the writer is of opinion that as the section only applies to documents "required by or for the purposes of the Act," and as a prospectus is not required by or for the purposes of the Act, the section has no application to a prospectus. Shareholders are already sufficiently protected against false statements in a prospectus.

Conversion of Stock into Shares.

A company which has converted fully paid-up shares into stock (see Companies' Act, 1862, Section 12) may, if so authorised by its articles as originally framed, or as altered by special resolution, reconvert such stock into paid-up shares of any denomination. [Section 29.]

PRACTICAL CONSIDERATIONS INVOLVED IN THE GENERATION OF POWER BY BLAST FURNACE GAS.

(*Concluded from page* 979.)

From the particulars already given, it will be apparent that *crude* blast furnace gas, as it leaves the furnace top, has a high temperature, usually contains more moisture than would saturate it at atmospheric temperature, and carries along with it dust and fume in proportions varying with the class of ore, fuel and flux, and the class of pig-iron produced, and also tar when coal is the fuel employed.

The application of this gas to boilers and heating stoves is, of necessity, only possible at a more or less considerable distance from the furnace top, and where it is to be burned at atmospheric pressure, it is of advantage to retain as much as possible of the physical temperature.

The moisture remains in the gas, and passes out in the products of combustion, all the time being in the form of steam. The heavier particles of dust are deposited all along the conducting tube, and in the boiler furnace, and lighter portions are even carried out of the chimney stacks, which shows that the passage of the gas in flues and tubes has a purifying effect, and that the term "crude" gas should only be applied to the gas as it leaves the furnace top; for more or less refinement of the gas, depending upon the distance between the furnace and the stoves, takes place, in a very inefficient manner, in proportion to the length of flues or tubing through which the gas has to travel.

The conditions most suitable for economic utilisation of the gas in boilers and stoves are the reverse of those most advantageous when it is applied for the development of power by direct combustion in the cylinders of gas engines, and statements frequently made of late of the utilisation of "crude" blast furnace gas in gas engines can only be taken in a very qualified sense. It would be ridiculous to attempt to use hot gas in a gas engine, or to suppose that gas carrying the proportion of dust usual on its evolution from the furnace, could be successfully employed to drive gas engines. It must be purified to a certain extent, and therefore is not "crude" gas; when properly designed apparatus is employed for treating the gas, all troubles due to high temperature, excessive moisture, and dust are removed, and gas of a very regular chemical composition and physical condition is delivered to the gas engine. At Seraing, in Belgium, it has been claimed that a 600-H.P. blowing engine is successfully driven by the gas from the blast furnaces without any special treatment, but when it is taken into consideration that near the furnace there is situated a large dust-settling chamber called a dry washer, and that the gas has to pass through 260 metres (853 feet) of tubing before it reaches the cooler, it does not require much knowledge of gas engineering or chemistry to understand that the gas is not "crude" when it reaches the gas engine, or in the most suitable and economical condition for firing boilers.

The successful application of blast-furnace gas to internal combustion engines requires that the crude gas must be cooled, for the following reasons:—

The cooler the gas the greater its density, and the smaller the cylinder required to develop a given power.

Any excess of moisture carried by the gas in the form of steam is reduced through precipitation, down to that amount only which produces saturation at the temperature at which the gas leaves the gas holder, practically about the temperature of the atmosphere.

The temperature must be rendered constant as well as low.

Also it will be obvious that the dust and any tar must be more or less perfectly prevented from entering the cylinder of the engine, the installation of apparatus specially designed for the purpose of arresting the dust, and rendering it easy of removal without necessitating the stoppage of the power plant, being a *sine quâ non*.

The variations in pressure where the closed top furnace is the source of gas supply must be overcome, and drawing the gas to the required point, where open top furnaces are still in existence, must be accomplished, by some mechanical means which is capable of passing the gas through the treatment apparatus and into the pressure-governing gas holder, as it is necessary that the pressure at which the gas is delivered to the engine should not be subject to variation.

The expenditure of heat to develop 1-H.P. hour is theoretically 2,545 British thermal units, and the gas engine is capable of turning from 25 to 28 per cent. of the heat of combustion of blast furnace gas to account.

From this it will be seen that to develop 1 H.P. by this system requires fuel in the form of gas capable of developing on combustion, per hour

at 25 per cent. = 10,180 B.Th.U.
at 28 „ = 9,089 „

By calculation, it is found that 1 cubic foot of each class of combustible gas, at 60° F., and 30-inches Bar., develops upon combustion—

Carbonic oxide	CO.	320 B.Th.U.
Hydrogen	H.	324 „
Marsh gas	CH_4	1,115 „
Ethylene	C_2H_4	1,577 „

For convenience, and taking into consideration the variation in the load factor, it may be taken that 1 H.P. can be developed under ordinary circumstances by an expenditure of 10,000 B.Th.U. per hour.

Characteristic Analyses of Blast Furnace Gas.

Averages of several Analyses from Furnaces in different Districts. Percentage Composition by Volume.

Fuel.	Carbonic acid.	Carbonic oxide.	Hydrogen.	Marsh gas.	Olefiant gas (ethylene).	Nitrogen.	Per cent. combustible.	Thermal value per cubic foot at (60° F., bar. 30".
—	CO_2	CO	H	CH_4	C_2H_4	N	—	B.Th.U.
Splint coal ...	7·2	25·8	4·5	3·4	—	59·7	33·7	135
„ „ ...	5·4	29·8	4·0	2·5	·2	58·1	36·5	139
Coal 6½, coke 1	9·0	23·0	6·8	1·4	—	59·8	31·2	111
Coke 4, coal 1 ...	6·4	27·4	3·0	2·6	—	60·6	33·0	126
„ 4 „ 1 ...	5·8	33·9	3·9	—	—	56·4	37·8	121
Coke	7·3	31·6	—	4·2	—	56·9	35·8	148
„	7·5	30·6	2·6	1·0	—	58·3	34·2	117
„	9·8	28·0	2·0	·3	—	59·4	39·8	105
„	8·6	29·4	0·4	2·8	—	59·8	32·6	126
„	8·0	30·7	3·3	·5	—	57·5	34·5	114
„	4·8	34·3	2·5	1·2	—	58·2	37·0	128

When a suitable compression is arranged and the ignition tube is sufficiently highly heated, the above varieties of furnace gas will produce 1 I.H.P.-hour with an expenditure of from 67 to 95 cubic feet, as compared with 500 to 700 cubic feet when burned in boiler furnaces.

The mean pressure upon the piston is greatly dependent upon the two factors of compression and ignition.

In 1894 there was a small installation put down at the Glasgow Iron and Steel Company's blast furnaces at Wishaw, to demonstrate the practicability of patents taken out by Mr. B. H. Thwaite for the utilisation of blast furnace gas in gas engines. These patents and their publication, with the arguments advanced by Mr. Thwaite in 1894, constitute the

earliest conception of the possibility of obtaining a very much greater economy in turning to account the thermal value of the gases evolved by blast furnaces.

The installation above mentioned has continued to develop electric light for the use of the works since its erection, and has frequently been referred to in publications as the pioneer of the system.

Very shortly after the starting of the Wishaw plant the Société Cockerill, of Seraing, made very exhaustive tests of the practicability of using blast furnace gas in gas engines, with the result that it was applied to blowing engines of 600 H.P. with success. German engineers followed suit with satisfactory results, and engines of high powers and of different systems have been turned out by important firms.

English iron masters have not been too adventurous, but several installations of considerable interest have been put down, or are in course of erection. One of these was described and illustrated in our last issue.

The reason why the subject is of such great importance to electrical engineers, of course, resides in the fact that, after providing the power required for blowing engines, there will in all cases be an enormous surplus of power, costing even less than that derived from waterfalls in other lands; hence it will be possible to carry on such profitable and growing industries as the manufacture of aluminium, calcium carbide, carobrundum, alkalies, pure copper, &c., in addition to the supply of light and power to the adjoining district, at a minimum of cost. In all these industries the electrical engineer must of necessity take a leading part.

THE POSITION OF DYNAMO MAKERS IN THIS COUNTRY AT THE CLOSE OF 1900.

That our manufacturing firms have been well supplied with orders during the past 12 months is a fact well known, and that the more prominent manufacturers have sufficient work in hand to keep their shops fully occupied for another six months is also apparent from the deferred deliveries which are being quoted at this present time.

Further, there is evidence on all sides of abundance of work which will keep dynamo makers busy for the next few years.

In spite of this seeming prosperity, however, there are points about our manufacturing firms which cannot be regarded in quite such a happy light from the commercial standpoint.

That such an unprecedented demand for dynamos and motors—a demand considerably greater than the supply, so far as the manufacturing capacity of this country is concerned—should, at the same time, be accompanied with very keen competition, and low prices in consequence, is scarcely what one ought to expect, or cares to look for.

This is only too apparent to those conversant with manufacturing costs and with the prices being daily offered on the open market.

One has not far to look for the cause of this. Large foreign manufacturers whose shops have to be kept partially filled with orders obtained from abroad, and who are anxious to get a hold on the British market, are largely responsible; whilst numerous new manufacturers, almost daily coming into existence in this country, are also responsible for keeping prices down, and for causing many of the public contracts to be given out at figures below cost price.

Our older established firms have not suffered appreciably by this competition during the past year, as being in a stronger position they have been able to choose their orders and to ensure a fair price in return. This means, however, that their business has been obtained chiefly from private companies, and not from public contracts, which, in spite of the existence of consulting engineers, are usually given out to the lowest tender, regardless of the make of machine or of the probable time that the manufacturer or importer is likely to remain in existence.

Viewing the situation broadly, one might be inclined to think that these matters of price would right themselves in the future—that importers would tire of selling machines at cost price, whilst young manufacturers would have advertised themselves sufficiently by giving their manufactures away, and would in turn be expecting to make a profit, and that this would come about before the majority of manufacturers had felt the pinch of competition due to the abundance of work obtainable in other quarters.

A fresh danger in the way of increased competition, however, threatens the situation.

The next 12 months will see established in our midst two new foreign manufacturing works, organised and equipped on most modern lines, and exceeding in size even from the commencement any of our own works.

Although in the ordinary course of events one welcomes engineers of whatever nationality who think fit to come and work amongst us, and even to start manufacturing in opposition, yet in the present case one cannot help feeling that large works of this description, requiring as they will do a large amount of work to keep them busy, may perchance, due to sufficient orders not being forthcoming at remunerative prices, be obliged to clear their stocks at unremunerative prices, to the disadvantage of the electrical industry in general, and of our manufacturing firms in particular.

Setting aside, however, for the moment this danger, one comes to the question whether a large manufacturing business possesses any material advantages over works of smaller size, such as are found established in this country at present, and whether, therefore, our own manufacturers are not allowing foreign firms to step in and do what they themselves ought to be doing.

The answer would appear to be that a large manufacturing firm works under certain advantages and obtains orders which a smaller firm is practically debarred from.

Due to manufacturing on a larger scale, the costs of the finished machine are somewhat reduced, which will enable their machines to be sold at a somewhat lower figure.

Further, large contracts usually find their way into the hands of the larger manufacturers, the smaller firms, *i.e.*, representing the largest manufacturers in this country, in many cases not even quoting. This is largely due to the time a small manufacturer requires to complete a large contract, as well as to the fact that few makers care about filling their shops with one large order, to the crowding out of more regular customers.

Large contracts consequently generally find their way into those shops that are capable of dealing with them expeditiously, and without serious inconvenience to existing orders.

Foreign orders can be secured more easily by a large firm than by a small one; in other words, it is difficult—and will be even more so in future—for small manufacturers to obtain foreign and Colonial orders in competition with the larger firms.

The representative or agent abroad, negotiating business for one of our manufacturers, will have little chance of securing orders when in competition with the representatives of foreign firms, who are able to offer quicker deliveries, and often at reduced prices.

It would appear that if British manufacturers are going to be satisfied with filling their shops with work obtained mostly at home, their present shops are large enough; but if, on the other hand, they are to keep in the foremost rank as manufacturers, both in our colonies and in foreign countries, in view of the great engineering works of our competitors, those responsible for negotiating the sales abroad will have to be backed up with larger works than any to be found in this country at present.

To rely on getting orders chiefly at home is not sound policy, though often better prices and lower selling costs prevail, yet there is always the fear of some unforeseen circumstance temporarily checking the demand, or lowering prices to such an extent as to wipe off all profit.

To be satisfied with getting orders at home, to the exclusion of foreign orders, is to be very easily satisfied, and further, means that as a nation we are willing to drop into a very secondary position as manufacturers of electrical plant. If, however, we are unwilling to take the necessary steps towards manufacturing plant ourselves for use abroad, the next best thing is to welcome foreign firms who will come and do so for us, who, by establishing themselves in our midst, are utilising our capital and labour, and who, on the

The successful application of blast-furnace gas to internal

arguments advanced by Mr. Thwaite in 1894, constitute the

strength of the good name possessed abroad and in our Colonies for machinery "made in England," will be able to compete with the large manufacturing establishments of America, Germany, Switzerland and Belgium, which are already making their influence felt in all those parts of the globe where there is any likelihood of electrical plant being in demand.

Finally, if the sales of these foreign manufacturers, who are laying down large shops in our midst to meet the demand for electrical machinery at home and abroad, are for any cause temporarily checked, the difficulty of over-production will be a serious matter—nothing short of a crisis—and will affect all manufacturers in this country, both large and small; if, on the other hand, they obtain a ready market abroad, which is quite to be expected, in competition with the manufacturers of the countries referred to above, the whole nation, and the British electrical industries in particular, will owe them a debt of gratitude for keeping before the notice of foreign countries the name of England, which would otherwise have surely dropped, more and more, into quite a secondary position.

Our chief hope, therefore, for keeping prices up in this country, lies in those large firms being able to keep their shops full with orders obtained largely from abroad.

Whether they can do this at remunerative prices remains to be seen, and only time can prove.

On the whole, the outlook at the present time for manufacturers is none too rosy—plenty of work but low prices is what they must be prepared to expect—and for this they have only themselves to blame. They have made no provision for the demand, and have allowed numerous competitors to step in.

ELECTRIC AUTOMOBILE TRIALS.

[COMMUNICATED.]

THE Chislehurst tests do not seem to have been scientific in their nature; apparently they only roughly indicate that one car as a whole is better than another, but wherein, or to what, the superiority is due cannot readily be ascertained from the results. A poor battery may serve a very finely constructed car, and, on the other hand, a good battery may waste its energy working a badly constructed vehicle, and even the personal factor in the shape of the driver may come in. Motors are so well made now that there is no reason why all cars cannot get them equally efficient. But the traction battery is in a transition stage from the stationary form to the traction type, and there is reason to believe that some of these later forms are much superior to others, but no information is forthcoming of a reliable nature from road tests as recently carried out.

For some traction purposes great capacity per pound weight is required, along with a fairly high discharge rate. To ascertain these on an actual road trial for comparison between competing cells, it is necessary, to make the results at all acceptable by any fair-minded scientific judge, that the cells should be tested under exactly the same conditions. This can only be done by taking a number of cells of each kind to form the battery and working them all together.

Suppose four different kinds of cells to be submitted for tests on a road trial, a vehicle should be selected to run with, say, 44 cells; 11 cells of each competitor should be formed into a battery to work the car. Under such conditions the trial is purely a test of cells, the best cell staying longest, and all that is required is a good dead-beat voltmeter across each set of cells, or, better still, one voltmeter with four contacts, so as to read the drop in each set on the same instrument.

From these readings immediately a cell falls in E.M.F., to a fixed limit, which may be to 1·85 at its lowest, then by dividing the distance traversed, or the hours of running, by the weight of the cell we get the true value of its tractive power. Assume cells A, B, C, D, thus tried with a fall to 1·85 volts in the order following:—

	Value.
A = 6 hours' running, weight 30 lbs. ...	$\frac{6}{30} = 2$
B = 4½ hours' running, weight 20 lbs. ...	$\frac{4·5}{20} = ·225$
C = 5 hours' running, weight 22 lbs. ...	$\frac{5}{22} = ·227$
D = 3 hours' running, weight 18 lbs. ...	$\frac{3}{18} = ·166$

Here C is the best cell for its weight, as it goes for greater time or distance per lb. = 0·227 hours per lb.

Then as to durability, it might be that the cell which made the above performance would be mechanically weak and have a very short life. This would be no drawback if its price were correspondingly low, it is necessary then to obtain the time of wearing out until renewal is required of the plates and the cost of renewal.

We may compare them by $\frac{V\,T}{C}$ where V is traction value as before found, and T time of durability, and C cost of renewals. Suppose cell C broke up at the end of 500 hours running, then $\frac{0·227 \times 500}{20}$ (assuming £20 as cost of renewals) would give the comparative value of the cell.

It must, however, be held in favour of cells of small weight, that even if under these two tests combined it comes out not so good, that the car carrying it is easier driven (and may be of less weight in practice).

Another important point in accumulator cars, not to be overlooked in trials, is that it is no use testing a light pleasure gig against a heavy parcel van, nor a vehicle made for long runs and one made for short runs; this matter is most important.

For the purposes to which electric cars are most suitable and desirable, long runs with one charge are not necessary. These light, smart, pleasant vehicles admirably fill the want for medical and business men making daily trips not exceeding 20 miles, often less than 10. It seems, therefore, absurd to drag about a battery heavy enough to go 50 miles, when one able to do 25 would be ample.

The 50 and 100-mile charge may have some advantages; if so, it can easily be obtained by adding plates to the cells, without any expenditure of inventive genius. Most people who want to do business would go on long journeys by rail. There is, however, a great field for a light car for city and town travelling with short daily trips never exceeding 20 miles per day, which, at a pinch, could do its 25 miles.

The 50-mile car is too heavy, without any corresponding advantages, and here comes in the importance of heavy discharge rates; the capacity diminishes as the discharge rate increases with any given battery.

If we consider a battery with 150 ampere-hours capacity at a discharge rate of 30 amperes, running a car 50 miles at a charge, and then say we want a battery of less weight to go only 25 miles at a charge. How is it to be done? Will it weigh only half the 50-mile battery? In both cases the power available must be the same, only the ampere-hours and the time of running down are halved; we must be able to draw up to the same maximum watt output at any moment.

From a well-known cell the following gives a result of actual test:—Discharge of 96 amperes for 7 hours, weight = 358 lbs., for No. 1 cell; for No. 2, discharge of 96 amperes for 3½ hours, weight 245 lbs. From these figures it will be seen that by halving the ampere-hours' discharge and keeping the volts and amperes the same, we do not halve the weight. Nevertheless as the cells have to propel themselves, the reduction in weight is an additional gain.

As all cells do not fall in capacity at the same rate under different discharge rates, it is important to ascertain for each kind of cell what its drop in capacity per pound weight is, when discharged at different rates, but it is still more important for traction purposes that we should ascertain the weight of each of two cells, one giving twice the ampere-hours of the other in double the time; say, one giving 150 ampere-hours in 6 hours, and one giving 75 ampere-hours in 3 hours, both to be discharged at 25 amperes rate continually.

In the above case large cells are selected as showing the

law of drop in capacity better than small cells; in the 7 hours' discharge at 96 amperes the number of plates is 25, and for 96 amperes for 3·5 hours the number of plates required is 17. It will be seen from this that small cells capable of very rapid discharge without much drop in capacity are of the utmost importance.

In any case where electric motor cars are seriously considered it is worth while investigating all these points and tests, and trials should always be directed towards ascertaining well defined results on some or all of them.

At any rate, it is a fact that many cars making runs of 50 or more miles on one charge as a display of power, are, when taken over by a customer, in most cases condemned to carry about a battery far too heavy for their actual requirements. Most users would like to be able to run at or above legal speeds, but few of them care to take 50-mile runs on roads. The lighter battery will go as fast with the same weight, but for a shorter time, and if we deduct the weight saved in the battery, it will be found that we can nearly reduce the battery by one half, by reducing the time over which a charge is to last by one half.

Long-distance charges are more likely to be irregular in charging, while short-distance charges, which are required at least daily, ensure greater regularity and certainty of receiving due attention. A 25-mile charge for a light car to carry three persons could be given in an hour, while two hours would be the normal time.

There is room for an enterprising movement in this direction. We have had plenty of attempts on the pattern of a steam road roller; we want something on the style of a light gig drawn smartly by a pony.

It is not necessary to try automobiles as we try horses, that is, as a whole, for while it is interesting it is not of much profit. A horse must run as a whole, but if he has good legs he may have bad lungs; we cannot replace the lungs with a better set, but in a motor car we are able to remove a faulty organ and put in a good one, hence the necessity for locating the different faults and good features.

THE NERNST LAMP.

Some at least of the numerous concessionaires of the Nernst patent rights appear to have completed their prolonged experimental researches to obtain a lamp which will stand the wear and tear of everyday use, and we may expect soon to find them on the market. The Allgemeine-Elektricitäts Gesellschaft, which owns the patents for Great Britain, Germany, and other northern countries of Europe, announced at their last annual meeting that they had already tried the lamps at several small towns in Germany, and were now about to introduce them on a large scale in Berlin. The Nernst Electric Light, Limited, a company floated in this country to purchase and work the Nernst patents for the colonies and dependencies (except Canada), and some undeveloped countries in South and Central America, have also at last worked out patterns of the lamp which they are about to make in quantities.

The Nernst Electric Light, Limited, was floated about two years ago, with a capital of £320,000, of which £270,000 was to be paid for the patent rights, that is to say, a profit of 40 per cent. would have to be made on the working capital to yield 5 per cent. to the shareholders. Considering that only £104,000 was paid for the patent rights of the carbon incandescent lamp (and that was considered too much), the price for the Nernst patents appears to be high. When the restricted field of operations of the Nernst Electric Light, Limited, is considered, the price paid appears to be out of all proportion to their value, unless the Nernst lamp is so superior to its rivals that it will sweep them all out of the field.

Even after two years' work to bring the lamp into practical shape, it is still doubtful whether the Nernst lamp will displace to any great extent either the carbon incandescent or the arc lamp. Mr. Swinburne has characterised the Nernst lamp as "the greatest invention in electric-lighting since the infancy of the industry." But Mr. Rathenau, the managing director of the company owning the English and North European patents, has said that the Nernst lamp, in spite of its simple appearance, is complicated in structure, and that its greater economy is discounted by the necessity for a secondary heating coil, and by the fact that the temperature of the radiating body is much higher than in the carbon lamp. Rathenau did not expect that the Nernst lamp would, on account of these disadvantages, displace to any great extent the ordinary glow lamp.

This was the opinion of Mr. Rathenau some two years ago. Has two years experimenting at the expense of shareholders, who thought that they had bought a complete invention ready to put on the market, materially improved the lamp? The efficiency, at least, appears to have fallen off. Mr. Swinburne, in his lecture before the Society of Arts on February 8th, 1899, gave the watts per candle-power as 1·5 watts for small lamps, and 1·6 watts for large lamps; in the latest accounts of the improved lamp, the watts per candle-power are given as 1·7; in another account, a Nernst lamp of the same candle-power as a carbon lamp took half the current, which would mean with the same voltage 2 watts per candle-power. The reduction in the efficiency has been, no doubt, considered advisable with the view of prolonging the life of the lamp.

If, however, the Nernst lamp would furnish with half the current the same amount of light as the ordinary lamp, without any accompanying disadvantages, then the carbon lamp would be doomed. But the Nernst lamp falls far behind the carbon lamp in simplicity and cheapness of construction. It has been stated that the lamp without the self-igniting apparatus costs 1s. to make, but the reversion to the use of the match must greatly limit the use of such a lamp. The lamp with self-igniting apparatus is naturally more complicated, and consequently more costly in construction and repairs.

In the discussion on Mr. Swinburne's lecture before the Society of Arts, Prof. Fleming pointed out that the efficiency of the Welsbach incandescent gas light falls off very quickly in the course of ordinary use. Now the composition of the Nernst filament is practically the same as that of the Welsbach mantle, and we should expect the same rapid falling off in efficiency; so that though a Nernst lamp may be kept alight for 1,000 hours, it may have reached the best age for superannuation long before that time has elapsed.

A difficulty in the construction of the Nernst lamp was predicted by Mr. Whitcher in our columns, the difficulty of making connections with the refractory filament on account of its very high temperature compared with the carbon filament. No grading down of temperature to the connections appeared to be possible, because the conductivity fell so rapidly with the temperature. This difficulty appears to have been the chief cause of the two years' experimenting. It appears to have been solved, in a way, by forming a blob of the refractory material round the platinum connections and bringing the platinum wire to the surface to reduce the temperature somewhat by radiation. The platinum lamp failed owing to the difficulty of keeping the connections cool; it is to be hoped that the Nernst lamp will not be shipwrecked on the same rock.

It was stated in the prospectus of the company that "the process of manufacture is very simple, and plant of an inexpensive kind only is necessary." Yet it has taken two years experimenting after the patents were sold to the public to work out this "very simple" process of manufacture; and in the report recently issued of the Berlin concessionnaire company, it is stated that the principal reason why the lamps have not been more rapidly put on the market is the difficulty experienced in training workmen to make the lamps.

Another difficulty which has to be met in the working of electrolytic lamps such as the Nernst is due to the liberation of ions at the connections, when continuous currents are used. Nernst for this reason found, at first, that a good connection could not be maintained at one of the electrodes. The reason why the lamp will not work with a vacuum bulb is said to be due to the fact that oxygen must be admitted to oxidise the metals liberated at the cathode. The two years of experimenting, we presume, has also got over this difficulty, but connections at which strong chemical reactions are continually taking place must be in a precarious condition.

The fire risks with the Nernst lamp must also be considerably increased. The latest forms are enclosed in a glass

globe, which may catch any red-hot filaments that may drop from the lamp ; but the use of the lamp in coal mines is out of the question.

The Nernst lamp, we are prepared to admit, has several good points ; the colour of the light is better than in the carbon lamp ; and, of course, the smaller consumption of power will count for much, if it turns out in practice that it is not counterbalanced by other disadvantages. We fail, however, to see how the shareholders of the Nernst Electric Light, Limited, can hope to get a decent dividend, when seven-eighths of the capital has been paid for patent rights which give them no exclusive right to make or to sell in any of the countries where the demand for electric lamps is greatest. The pick of the markets has been given to other concessionnaires, who apparently have paid much smaller sums for their concessions.

The evolution of the lamp itself has been brought to a very advanced stage by the efforts of Messrs. Drake and Sheppard and a talented staff of assistants, under the supervision of Mr. Swinburne.

There appears to be at least as much external difference between the present form and the original clumsy and

Fig. 1.—Spirit-Lighted 16-c.p. Lamp.

unsightly pattern as between the early bamboo and cotton thread lamps of Edison and Swan and the latest type of carbon glow lamps. It is true that this does not reflect any credit on the vendors of the patents, who should have done this work themselves, but, on the other hand, the great progress made speaks well for the skill and energy of the company's staff.

The accompanying figures illustrate some typical patterns in which the lamp is now made. Fig. 1 represents the spirit-lighted 16-c.p. lamp complete, while fig. 2 shows the working parts, minus the globe. It will be seen that the top of the lamp consists of a brass cap fitting the standard

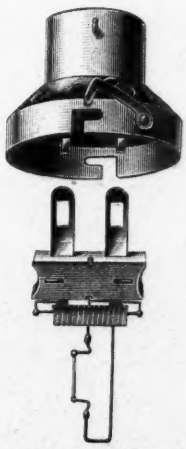


Fig. 2.—Working Parts of Spirit-Lighted Lamp.

bayonet-holder ; the contact plates are connected with two hooks, from which is suspended the replacement piece. The latter is composed of a biscuit porcelain block carrying two brass eyes, which support the nickel leading wires ; to these are joined short platinum electrodes, which are connected with the filament of mineral oxides by means of small "blobs" of the same material.

The series resistance which is necessitated by the ten-

Fig. 3.—Automatic 16-c.p. Lamp.

dency of the filament to rush up to an excessive temperature, thanks to its large negative temperature coefficient, consists of an extremely thin platinum wire wound on a triangular

Fig. 4.—Automatic Lamp, 32 and 50-c.p.

rod of porcelain, seen just below the porcelain base block in the illustration. Lastly, the frosted globe is carried by the locking bayonet attachment seen on the underside of the

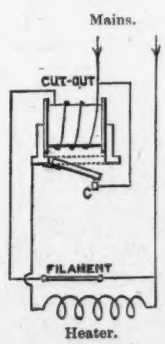


Fig. 5.

cap. A hole in the lower part of the globe allows of the lamp being "lighted" with a spirit torch.

Fig. 3 shows the *ensemble* of a 16-c.p. self-lighting lamp,

and fig. 4 that of the 32 and 50-c.p. lamps. These are fitted with a small electric heater and automatic cut-out, in addition to the parts described in connection with the non-automatic lamp.

The connections of these lamps are shown in fig. 5. The heating coil is mounted below the filament, and is connected with the contact c, so that when the lamp is first switched on the current passes through this coil, making it red hot. In passing, we may mention that the coil is made of a spiral thread of biscuit porcelain overwound with fine platinum wire. The filament is heated by radiation and convection from the coil until it becomes a conductor; the moment this happens, the current flowing through it actuates the little relay—a beautifully neat and compact device in the top of the lamp—and cuts off the connection with the heating coil, leaving the filament alone in circuit, with its steadying resistance. Watching the globe of the lamp when it is first switched on, one sees first the red glow of the heating coil; this suddenly dies out, and the bright white light of the filament shines forth—the whole cycle occupying 5 to 10 seconds.

The heating coil, resistance, and filament, which constitute practically the whole of the parts liable to injury or deterioration, are at present included in the replaceable attachment, as with the non-automatic lamp; there must therefore be three terminals, not interchangeable. To attain this object, a central spring piston contact is used in conjunction with a long and a short hook; thus the attachment cannot possibly be put on except in the right way. In the larger lamps some trouble was met with through the burning of the relay coil by connection from the incandescent filament; this was entirely overcome by Mr. Drake's patent ventilating cage separator, seen in fig. 4.

The life of the filament is about 500 hours; during this time the efficiency slowly falls from 1·7 to 2·0 watts per candle. An initial efficiency of 1·5 watts per candle is readily attainable, but for the present the above values are in use.

The tendency of the electrode at the + end of the filament to get excessively hot has been overcome by prolonging the platinum connections to form a little star at each end of the filament, so as to keep the ends cool by radiation. This device is necessary at both ends, because one cannot foresee the direction of the current through the filament.

It remains to add that the filaments are now standardised for 8, 16, 32 and various other candle-powers, for circuits of 100 volts upwards.

The quality of the light, throughout the life of the lamp, is remarkably pure and white, and the heating coil of the automatic lamps does not appear to interfere with the light distribution appreciably. The various parts of the apparatus are very neat and well made, and the whole forms a thoroughly workmanlike system.

THE ELECTRICAL ENGINEERS (R.E.) IN SOUTH AFRICA.*

By Lieut.-Colonel R. E. Crompton, E.E. (R.E.) V.

At the request of your President I have prepared a narrative of the war services of the small body of electrical engineers who left England early in the spring of this year for South Africa, and who have now returned.

I must commence by reminding you that the corps of Electrical Engineers (R.E.) Volunteers was raised, by the help of this Institution, in order to enable electrical engineers to place their services at the disposal of the country in case of need. It is acknowledged that every year electrical appliances will be more and more used in military operations. Up to last year the special work on which the corps had been instructed and drilled for home service has been the management of the searchlight apparatus used at various points for coast defence, to which has been added some instruction in submarine mining and cognate matters. As both officers and men of the corps felt that the training which everyone in the electrical profession must go through had made us all handy men, not only for electrical, but for general mechanical engineering work, we offered our services for the war in South Africa.

The equipment has already been described in the technical journals; I will remind you that its main features are portable searchlights mounted on carriages somewhat similar to those used for field artillery guns, the electrical energy being generated by dynamos carried on small compound steam traction engines. Special cable carts were also provided.

The *Tagus* arrived at Cape Town on the 4th, and the Unit disembarked on the 6th, and were encamped at Fort Knokke for a few days. The *Custodian* arrived on April 12th, and the equipment, including two of the 8-ton traction engines and four 5-ton wagons, were unloaded that night.

Colonel Girouard, the Director of Railways, at once applied to have the Electrical Engineers attached to the railway re-construction trains, and they were ordered to get ready to move up country as quickly as possible. On Saturday night, April 14th, the whole of the equipment was packed on five large bogey trucks, but even their start seemed likely to be delayed as the line was blocked with press of traffic. On Monday morning the Unit suddenly got orders to start. After a journey of three days and four nights it arrived at Bethulie at 5 a.m., April 20th, and at once off-loaded the equipment, and within a few hours the first installation of temporary electric light for war purposes was erected on the Bethulie road bridge, which was then temporarily in use for railway purposes, during the time that the low-level deviation railway bridge was then constructed by the Railway Pioneer Regiment to replace the original railway bridge which had been destroyed by the Boers.

The first time the field telephones were put to work was at this place. A line was laid across the bridge for the use of the railway, and a good telephone service established. On May 6th the Unit arrived at Bloemfontein and was split up into two sections, one going on direct to Railhead, which was then at Vet River, the other section remaining at Bloemfontein to carry out the electric lighting of the goods yard and locomotive shops. The advance section at Vet River joined the reconstruction trains and remained with them during the months of May and June—*i.e.*, until the work of reconstructing the railway was completed through the Orange Free State up to the Vaal River.

The work at Vet River may be taken as typical of many other works at which it was necessary to work all night by artificial light. The Railway Construction Corps R.E. was engaged in constructing a main bridge across the river approached by long deviations from the main line, in these were three smaller bridges. The lighting plant had therefore to be erected at each of these bridges in turn.

When the Vet River work was completed the section moved on to Smaldeel, and there was joined by Major Crompton with a draft which had left Cape Town on May 4th. Major Crompton brought with him a third traction engine with its dynamo, an additional supply of concentric cable, two additional 5-ton wagons, stores, bicycles, &c. Major Crompton then took over the command of the unit, and, as the occasion arose, the whole of the Bloemfontein section with their stores were gradually moved up to join the unit, leaving only a small detachment of six men under the command of Corporal Bicker Caarten to work the temporary lighting plant at Bloemfontein.

Early in May Colonel Girouard required the services of additional railway telegraph men, and Captain Bain was detailed for this work, and with a detachment of seven men, was sent on to repair the telegraph in advance of Railhead. This was a service of great importance, entailing considerable personal risk and exposure.

The No. 1 section commenced lighting work at Zand River on May 18th, this work being of a very similar nature to that of the Vet River. It afterwards advanced with the Railhead Construction trains to the Rhenoster Spruit to assist the working party building a crib bridge at that point. Here a particularly smart piece of lighting work was carried out. The orders were received at 2 p.m. The traction engine was off-loaded from its truck, and hauled its wagons and stores down to Rhenoster Spruit, three miles away, the light stores going down the damaged railway line on a trolley. Eight arc lamps were fixed on poles, and light was furnished to the working party by nightfall, 5.30 p.m.

The new and first reconstructed bridge at Rhenoster was completed on the 29th, and there being then no large work ahead requiring arc lights, the detachment went forward with the construction train.

During the next eight days the detachment had an exciting time, as the enemy under De Wet and Theron were threatening the line and reconstruction works. The electrical engineers formed part of the reconstruction day shift, the working hours being generally from 6 a.m. to 6 p.m., but sometimes up to 12 midnight, so that on these days the men were 18 hours consecutively at work.

During the time that the arc lights were being used on the bridge at Taibosch on the nights of the 7th and 8th Lieutenant Pott succumbed to enteric fever. This was a great loss to the Unit, as this officer had himself designed a great portion of the arc lighting and projector plant, and the loss of his services greatly crippled the Unit. He had to be left at Viljeonsdrift, where he was nursed with extreme care by Dr. and Mrs. Dixon, Dr. Dixon being the medical officer to this section of the railway.

Here Sapper Weakly also fell ill of enteric fever, probably brought on by the exposure at Roodeval. He lingered for some time, and eventually died at Viljeonsdrift on the 27th.

Railhead reached the Vaal River on June 10th, and at this point an installation of 12 lamps was erected, and on the 11th the first train crossed into the Transvaal and some supplies were sent to Lord Roberts at Pretoria.

It may be here remarked that as during the advance of railhead from Bethulie to the Vaal the arc lamps were worked on 19 nights, it is probable that the period of reconstructing the line was shortened by nearly the same number of days, but even if one night's work is only considered to be equal to two-thirds of a day's work

* Abstract of lecture delivered before the Institution of Electrical Engineers on December 20th.

the night work rendered possible by the section must have hastened the advance of railhead by not less than 12 days, and the money value alone of this to the nation must have many times repaid the entire cost of equipping and sending out the Electrical Engineers.

After arriving at Pretoria, the engineer-in-chief found quantities of electrical work for the corps, as all the forts which defend the town had been fitted up with various electrical apparatus, not only for electric lighting but there were signal signalling, telephone and other wires, which required to be sorted, labelled, and their uses understood.

The oil engines which supplied the motive power for driving the dynamos had purposely been damaged by the Boers, and had to be repaired and set to work. The small and efficient searchlights which had been used by the Boers were replaced by a system of incandescent lamps placed so as to illuminate certain points which were liable to be threatened by the enemy during night attacks.

This work at the forts, which was of a very interesting nature, was followed by teaching the garrisons how to use and maintain the electrical apparatus in working order.

Other parties of our men were employed in fitting up electrical lighting in various public buildings which served as supply stores, and in the large hospitals which were then being started, inside and outside Pretoria. In some cases these new installations were worked from the public supply of the town, in other cases separate generating machinery, *i.e.*, steam engines, dynamos, and systems of conductors had to be put down for each job. The plant for this was made up from material found at or near Pretoria, most of which was in a damaged condition and had to be almost remade before it could be usefully employed.

During this time, as the whole of the Rand district surrounding Johannesburg is supplied with electric light and power partly from a distant generating centre at Brak Pan. The military governor of Johannesburg asked for and obtained the services of Captain Leaf as his electrical adviser, and from time to time various works were supervised by him and by other officers of the corps, so that the electrical plant of Johannesburg and district was gradually got into order.

Early in July Electrical Engineers were several times called upon to extricate an engine which was proposed to be used to haul 12-ton 6-inch quick-firing guns to various positions near Pretoria. The engine and gun was hauled out of a drift almost in the middle of Pretoria, into which it had sunk in the course of an experimental run.

A few days later, after the driver of this engine had placed the gun in position near Deerdepoort, he took his engine down to a spruit in order to fill up his water tanks, but approached too closely to the soft ground, so that the engine turned over on its side and could not be got out until we were sent for.

Great praise is due to Captain Lloyd and Captain Leaf and the the detachment engaged on this work, which was carried on throughout the night. The way in which the Electrical Engineers handled the engines and gun made it evident to the officer commanding the artillery that the Electrical Engineers were so capable that he placed the engine and two guns in their charge, and the subsequent work of placing these, the heaviest guns ever taken into the field, was carried out by the officers and men belonging to the corps.

On July 24th a 6-inch quick-firing gun, weighing with its carriage 12½ tons, was hauled to the top of Quagga Kop, seven miles to the west of Pretoria, and 1,300 feet above it; the average slope up which the gun was hauled was 1 in 10, but there were point parts of it which were steeper.

Early in June a part of the detachment left at Bloemfontein left under Lieutenant Stubbs, and worked under the Army Telegraphs repairing telegraphs and erecting new lines. They trekked the whole journey from Bloemfontein to Pretoria, only arriving at Pretoria towards the end of July. After their arrival at Pretoria, Lieutenant Stubbs's party were employed for some time on new telephone lines connecting the forts with the town, and later on took another party down westwards to Standerton.

Towards the latter part of August a party of Electrical Engineers, under Captain Lloyd, were sent up to Brugspruit with a set of searchlight apparatus and accessories, which was erected, and the light shown from the top of the shaft of a colliery near Brugspruit Station, the dynamo being driven from the mine engine. Captain Lloyd returned to Pretoria, and left the detachment for some weeks under the command of Lieutenant Bigg, and there is no doubt that the presence of this searchlight greatly reduced the liability of night attacks from a strong commando under Erasmus, which threatened the Pretoria and Delagoa Bay Railway at this point.

On September 4th one of the engines, with dynamo and 16 arc lights, were taken down to Machadodorp by Captain Leaf and a small party of Electrical Engineers, and at this point an installation was erected to supply light to the various running sheds and loading stages, as at that time convoys which supplied three columns with food had here to be loaded.

Up to the time of the arrival at Pretoria, as the officers and sappers were constantly employed on railway work, little opportunity was given for the sappers to use the bicycles, but after arrival at Pretoria they proved to be of the greatest value; for as the work at the forts and buildings were scattered over a large area it necessitated the officers and men moving rapidly from point to point, and the whole of the bicycles were in full use, so by their aid the 20 men who rode them were almost doubled in value. On September 17th the writer, accompanied by Captain Leaf, was sent down by Lord Roberts to the low country to the east of Machadodorp, in order to report whether any of the traction engines could be efficiently used there.

Early in October the writer was ordered to England by Lord Roberts, in order that his recent experience might be utilised in designing traction engines for military purposes. Captain Lloyd re-assumed command. From this date the work went on uninterruptedly until the later end of October. It was whilst in charge of his Standerton detachment that Lieutenant Stubbs so nearly lost his life. Towards the end of October orders were received from the engineer-in-chief to concentrate the unit and hand over the majority of the stores so as to be ready to move homewards on receipt of further orders. The various detachments were gradually collected, and on October 25th, exactly four months since they arrived in Pretoria, the unit steamed south for Bloemfontein. Seven men were left behind in Pretoria to take their discharge there; four of these had been given civil employment under the Imperial Military Government, and three were taken up by private employment on the Rand. A 48 hours' journey took us to Bloemfontein, where we completed the handing over of equipment and packing for our final departure. Yet one more check was met ere the unit finally arrived at Cape Town. No transport was absolutely ready, and so, to avoid the possibility of the hardened and fierce warrior striking terror into the hearts of the peaceful inhabitants of Cape Town, the bloodthirsty Electrical Engineers were kept for three days in the safe camp of Stellenbosch, and not until Saturday, November 17th, did they reach the port, where the train took them right alongside the *Norham Castle*. After an uneventful and extraordinarily fine passage the ship was brought alongside the quay at Southampton on the evening of December 6th.

LEGAL.

Crow *v.* the Board of Works for the District of Whitechapel.

This case came before a Divisional Court of the Queen's Bench, composed of Justices Kennedy and Darling, on Wednesday last week, on defendants' appeal from a decision of Mr. Dickinson, the magistrate sitting at the Thames Police-court, in June last.

It appears that a summons was taken out by Mr. Crow, the district surveyor, against the defendants for not having given him notice under Section 145 of the London Building Act, 1894, before commencing the construction of a number of boxes, or inspection chambers, under the streets in the district for the purpose of electric lighting. The defendants were the local authority within the meaning of the Electric Lighting Acts, 1882 and 1888, for the district, and in the year 1892 were granted by the Board of Trade, pursuant to the Electric Lighting Acts, 1882 and 1888, in respect of such district a provisional order called the Whitechapel District Electric Supply Order, 1892, which was afterwards confirmed, and came into force on June 27th, 1892. By Sections 11 and 12 of this order the "undertakers" were authorised to construct in any street any such boxes as might be necessary for purposes in connection with the supply of electric energy, including apparatus for the proper ventilation of such boxes. The sections further provided that "every such box shall be for the exclusive use of the undertakers and under their sole control, except so far as the Board of Trade may otherwise order, and shall be used by the undertakers only for the purpose of leading off service lines and other distributing conductors, or for examining, testing, regulating, measuring, directing, or controlling the supply of energy, or for examining or testing the condition of the mains or other portions of the works, or for other like purposes connected with the undertaking, and the undertakers may place therein meter switches and other suitable and proper apparatus for any of the above purposes. Every such box, including the upper surface or covering thereof, shall be constructed of such materials, and shall be constructed and maintained by the undertakers in such manner as not to be a source of danger, whether by reason of inequality of surface or otherwise." Section 12 further provided that the undertakers should, one month before the commencement of such works, serve a notice upon the Postmaster-General describing the proposed works, together with a plan of the proposed works, and in addition a like notice and plan upon the County Council. The defendants did not, before commencing the construction of the boxes in question, serve Mr. Crow, as the district surveyor, with notice of the intended work under Section 145 of the London Building Act, 1894. Mr. Crow's contention was that the boxes came within the definition of "building structure or work" in Section 145, and that the defendants were bound before commencing the work to serve upon him as the district surveyor a "building notice," as prescribed by the section. The defendants contended that the Act of 1894 did not apply at all to boxes constructed in the streets under the provisional order, inasmuch as the order contained a complete code regulating the materials, situation, and mode of construction of such boxes and provided a complete machinery for enforcing such regulations, and with which special code and machinery the London Building Act of 1894 was inconsistent. The magistrate found as a fact that the boxes so constructed were "buildings, structures, or works," within the meaning of Section 145 of the London Building Act, 1894, and having regard to Sections 72, 201, and 203 of the said Act, he held that the provisions of Section 145 was not inconsistent with the special Act, and imposed on the defendants the nominal penalty of 1s., and ordered them to pay £10 10s. costs. From this decision the defendants now appealed.

Mr. H. F. Dickens, Q.C., and Mr. Talbot appeared for the appel-

lants (defendants), and Mr. Horace Avory for the respondent (Mr. Crow).

At the conclusion of the arguments, their Lordships reserved judgment.

Wolverhampton Corporation *v.* B.E.T. Co., Limited.

In the Chancery Division on Thursday last week Mr. Justice Joyce had before him a further application in the case of the Mayor and Aldermen, &c., of Wolverhampton *v.* British Electric Traction Company, Limited, judgment in which was delivered early in December.

Mr. Hughes, Q.C., for the Corporation, said that in drawing up his Lordship's order a question had arisen with regard to the payment of interest since the date on which the purchase ought to have been completed. The Act of Parliament allowed to the tramway company 5 per cent. interest should delay occur in taking over the line within the borough, but the Corporation had duly tendered the sum agreed upon, £4,250, but defendants had refused to accept it unless the Corporation granted them certain running powers, for which they counterclaimed in the action, and on which his Lordship had decided against them. The Corporation were entitled to profits made on the running since the tender was made, or compensation, but the other side had assured him that no profits had been made, and taking an account would necessarily be a matter of difficulty. He proposed that the Corporation should receive 5 per cent. interest on the amount of their tender, and that that should be the sum for compensation, the inquiry being waived.

Mr. Thompson, for the defendant company, argued that no proper tender had been made.

Mr. Justice Joyce made an order to the effect that the Corporation were entitled to 3 per cent. interest in lieu of compensation for non-completion of the purchase from the date the purchase-money was tendered.

THE ASSESSMENT OF AN ELECTRIC SUPPLY COMPANY FOR INCOME-TAX.

An important, and at the same time a most difficult, branch of the law relating to electricity is that which prescribes the methods whereby an electric supply company is to be assessed for payment of income-tax. The correct interpretation of the Property Tax Act of 1842, even when applied to concerns which were in existence at the passing of the Act, has never been a simple matter; small wonder, therefore, that difficulty besets the path of anyone who attempts to enumerate and classify the deductions which may lawfully be made from the profits of a company whose staple commodity is electricity. Again, the absence of judicial authority renders it difficult to apply the provisions of an old statute to a "trade or concern" which cannot even have been in the mind of the legislator in the year 1842.

Income-tax, as its very name implies, is a tax upon *profits*. In order to arrive at the actual profit of a concern upon which 1s. in the £ must be paid, the manufacturer is entitled to make certain "deductions," which were apparently so numerous in 1842, that the Legislature, instead of enumerating those which *may*, have set out those which *may not* be made.

By Section 65, Schedule A, r. III. of the Property Tax Act, 1842 (5 and 6 Vict., c. 35), it is provided (*inter alia*) that the annual value of all the properties thereinafter described shall be understood to be the full amount for one year, or the average amount for one year, of the *profits* received therefrom within the respective times therein limited. The value of ironworks, gasworks . . . . waterworks . . . . railways, and other ways . . . . and other concerns of a like nature, from or arising out of any lands, tenements, hereditaments, or heritages, is estimated on the profits of the year preceding.

The comparatively recent date of electrical undertakings on a large scale, and their close similarity to gas and water undertakings, have rendered it unnecessary for the Legislature to make new rules as to their assessment for income-tax.

This duty is to be charged on the person, corporation, company, or society of persons, whether corporate or not corporate, carrying on the concern, or on their respective agents, treasurers, or other officers having the direction or management thereof, or being in receipt of the profits thereof, on the amount of the produce or value thereof, and before paying, rendering, or distributing the produce or the value, either between the different persons or members of the corporation, company, or society engaged in the concern, or to the owner of the soil or property, or to any creditor or other person whatever having a claim on or out of the said profits; and all such persons, corporations, companies, and societies respectively shall allow out of such produce or value a proportionate deduction of the duty so charged, and the said charge shall be made on the said profits, exclusively of any lands used or occupied in or about the concern.

The rules to be applied in estimating the profits of a concern are laid down in Schedule D of the Act of 1842 (Section 100), which, by virtue of the Customs Act Amendment Act, 1866 (29 Vic., c. 36, Section 8), are applied to Schedule A, r. III. set out above. The following table gives, in a form, the deductions which *cannot* be made for the purpose of ascertaining "profits or gains." Thus no sum shall be set against or deducted from, or allowed to be set against or deducted from such profits or gains:—

(*a*) On account of any sum expended for repairs of premises occupied for the purpose of such trade, manufacture, adventure, or concern, nor for any sum expended for the supply or repairs or alterations of any implements, utensils, or articles employed for the purpose of such trade, manufacture, adventure, or concern *beyond* the sum usually expended for such purposes, according to an average of three years preceding the year in which such assessment shall be made; nor

(*b*) On account of loss not connected with or arising out of such trade, manufacture, adventure, or concern; nor

(*c*) On account of any capital withdrawn therefrom; nor

(*d*) For any sum employed, or intended to be employed, as capital in such trade, manufacture, adventure, or concern; nor

(*e*) For any capital employed in improvement of premises occupied for the purposes of such trade, manufacture, adventure, or concern; nor

(*f*) On account or under pretence of any interest which might have been made on such sums if laid out at interest; nor

(*g*) For any debts, except bad debts proved to be such to the satisfaction of the Commissioners respectively; nor

(*h*) For any average loss beyond the actual amount of loss after adjustment; nor

(*i*) For any sum recoverable under an insurance or contract of indemnity.

Again, it is provided by the fourth part of the first case under Schedule D of the Act of 1842, that in estimating the amount of the profits and gains arising on trade no deduction shall be made on account of any annual interest, or any annuity or other annual payment, payable out of such profits or gains.

By the indorsement on the *return for assessment*, with which every taxpayer is familiar, the following deductions are allowed:—

1. For repairs of premises occupied for the purpose of the trade or manufacture, and for the supply or repair of implements, utensils, or articles employed, not exceeding the sum usually expended for such purposes according to the average of the three years preceding.

2. For bad debts, or such part as shall be proved to the satisfaction of the Commissioners to be bad; also doubtful debts according to their estimated value.

3. For the rent of premises used solely for the purposes of business, and not as a place of residence.

4. For a sum not exceeding two-thirds (as the Commissioners shall allow) of the rent where any dwelling house is *partly* used for the purposes of business.

5. For the *annual value* on which duty has been paid under Schedule A of any premises occupied by the owner *solely* for the purposes of business, and not as a place of residence.

6. For a sum not exceeding two-thirds (as the Commissioners shall allow) of the annual value on which duty has been paid under Schedule A on any dwelling house occupied by the owners, and *partly* used for the purposes of business.

7. For any other disbursements or expenses wholly and exclusively laid out for the purposes of trade.

It is further provided in the Act of 1842 that in estimating the duty to be charged in respect of any trade or manufacture, and in order to arrive at the "balance of profits," no sum shall be set against or deducted from, or allowed to be set against or deducted from such profits or gains:—

(*a*) For any disbursements or expenses whatever, not being money wholly and exclusively laid out or expended for the purposes of such trade, manufacture, adventure, or concern; nor

(*b*) For any disbursements or expenses of maintenance of the parties, their families or establishments; nor

(*c*) For the rent or value of any dwelling house or domestic offices, or any part of such dwelling house or domestic offices, except such part thereof as may be used for the purposes of such trade or concern, not exceeding the proportion of the said rent or value hereinafter mentioned; nor

(*d*) For any sum expended in any other domestic or private purposes, distinct from the purposes of such trade, manufacture, adventure or concern, or of such profession, employment, or vocation.

Further, the computation of the duty to be charged in respect of any trade, manufacture, adventure, or concern, or any profession, whether carried on by any person singly, or by any one or more persons jointly, or by any corporation, company, fraternity, or society, shall be made exclusive of the profits or gains arising from lands, tenements, or hereditaments, occupied for the purpose of such profession, trade, manufacture, adventure or concern.

Again, the computation of duty arising in respect of any trade, manufacture, &c., carried on by two or more persons jointly must be made and stated jointly and in one sum. Inasmuch as electric lighting concerns are usually owned by companies, it is hardly necessary to refer further to these.

Among the few cases which can be found in the law reports relating to the payment of income-tax by corporations, there is one which decides conclusively that to supply water for the benefit of ratepayers is not to carry on a trade within the meaning of the Property Tax Act, and that the surplus profits so made are not assessable to income-tax. It is proper to infer from this that a corporation supplying electricity to ratepayers whether for light or power, is not carrying on a trade. A distinction must, however, be drawn between the supply of electricity to ratepayers within the area of supply and the sale of electric energy to persons residing outside that district. There is authority for saying that under such circumstances income-tax is payable on profits earned outside the municipal district, and the expense of laying cables, &c., within the municipality cannot be set off against such profit.

The following cases, which will serve to illustrate the foregoing principles, must be taken with the reservation that they have been

decided in connection with water or gas. The electric lighting provisional order might well contain modifying clauses.

Thus the Glasgow Water Commissioners were empowered by a local Act to borrow money and to acquire certain waterworks, and to bring in an additional supply of water. They were also empowered (1) to levy a compulsory rate on persons who chose to take water beyond the boundaries, and (2) to fix a rate for persons who chose to take water beyond the boundaries, and (3) to sell water to manufacturers and others. The Act required the Commissioners to levy a rate sufficient, along with the other income, to defray the annual interest or debt, annual expenses, and a sum of not less than 1 per cent. on the money borrowed, to form a sinking fund for the redemption of the debt. The Act directed that any surplus in one year should be applied to reduce the rate within the compulsory area in the following year.

It was decided that, in the absence of any evidence that the Commissioners were making profit by selling water beyond the compulsory boundaries, the Corporation, being merely the instrument of the ratepayers, could not be said to be trading in any commodity, and that the surplus, after paying expenses, was not assessable as profits under the Income-Tax Acts. [Glasgow Water Commissioners *v.* Inland Revenue, 2 Scotch. Sess. Cas., 4th Series, 708; 12 Sc. L.R. 466.]

But it was held in the case of the Glasgow Corporation *v.* Miller, [50 J.P. 503], that the Glasgow Corporation Water Commissioners are liable to assessment in respect of surplus revenue derived from supplying water beyond the area of compulsory supply and from the sale of water for purposes of trade.

The Corporation of Haverfordwest were empowered under a local Act, after lighting their town, to supply private customers with gas. From such supply profits were earned, in respect of which the Corporation were assessed to income-tax. They sought to deduct from the profits the moneys expended by them in laying out the streets. It was decided, however, that inasmuch as the Corporation did not carry on a trade so far as their duty of lighting the public streets was concerned, expenses so incurred were not moneys wholly and exclusively laid out or expended for the purposes of a trade within the meaning of Sched. D, r. 1, of 5 & 6 V., c. 35, Section 100, so as to entitle the Corporation to deduct such expenses from the above-mentioned profits. [Dillon *v.* Haverfordwest Corporation, 60 L.J., Q.B. 477; (1891) 1 Q.B. 575; 64 L.T. 202; 39 W.R. 478.]

In the case of the Corporation of Dublin *v.* M'Adam [20 L.R. (Ireland) 497] the facts were shortly these:—By the Dublin Corporation Waterworks Act, 1861, the Corporation were empowered to construct waterworks for the supply of water to the Borough of Dublin and certain extra municipal districts, and were authorised to borrow money for the purposes of the Act on the rates leviable under it, and empowered to levy certain rates on the owners and occupiers of property within the borough. They were also authorised to contract with owners or occupiers of property in the extra municipal districts for the supply of water for domestic use, and to charge rate or rent for such supply, to be called "a contract water-rate." By the Dublin Waterworks Act, 1870, it was provided that the income derived from the extra municipal districts should form, with the city rates, a consolidated fund, available for the payment of principal and interest of loans, and applicable to all the purposes of the Act. It was decided that the excess of receipts over expenditure in respect of extra municipal districts, was liable to income-tax.

The principle laid down in the foregoing cases can have no application to electric lighting undertakings by private companies, where statutory powers are obtained for the purpose of private as well as for public supply. All the expense of uprooting the streets, &c., properly incurred by the company, may be deducted when income-tax returns are being made out. Seeing that private electrical companies in this country are assessed to payment of income-tax just like other manufacturers, it is interesting to refer to the state of things in the United States. In that country—or rather in that group of countries, for each State has its own laws upon the subject—electric light companies are often taxed in the same manner as ordinary manufacturing corporations, and in many States there have been no special Acts passed which expressly apply to them. In many States the tax laws exempt from taxation manufacturing companies incorporated in the State, and carrying on their business within the State. It is an open question in most States whether electric light companies, and other electric companies, are to be considered as manufacturing companies under these statutes. It has been held several times in Pennsylvania, however, and must now be regarded as settled law there, that a corporation whose business is producing electricity and selling it to customers for the generation of light, heat and power, is not a manufacturing company within the meaning of these exemptions. [Com. *v.* Northern Electric Light and Power Company, 145, Pa. St., 105.]. Again, in New York, it was found necessary to pass a special Act which expressly taxed electric light, heat and power companies as such, for in the case of the Brush Electric Manufacturing Company *v.* Wemple [129, N.Y., 543] it had been held to be exempt on the ground of its being a manufacturing company.

CORRESPONDENCE.

Electrical Engineers Volunteers.

In your issue of October 26th, page 673, occurs a list (incorrect by the way) of the members of the above Corps who are remaining in South Africa, followed by the paragraph:—"The above N.C.Os. and men have, through the great influence and popularity of Major Crompton, together with the great trouble he has taken on their behalf, obtained some excellent appointments, and desire to thank him through the medium of these columns."

Though it will be some time before this can reach you, I cannot let this statement pass without challenge.

The writer of the article had absolutely no authority for the concluding clause.

At the time when Major Crompton left for home, not more than one or two of the men had obtained appointments of any kind, and any good fortune which may have befallen them since, has been rather in spite of, than owing to, any influence from the military side. As an instance of the facilities offered to men intending to remain, I may mention that it was just one month after the Corps left Pretoria, before we obtained our discharges.

A. E. Levin.

Pretoria, *November 27th*, 1900.

[The list referred to was incorrect only in the inclusion of Sapper R. W. Holliday, who has returned to this country. The accuracy of our statement is sufficiently shown by the fact that of the six N.C.Os. and men named therein, five did remain in South Africa. As for the rest of the article challenged, we have to say that the information was derived from a source to which we attach at least as much weight as to the above letter.—Eds. Elec. Rev.]

SOME RECENT TESTS ON ELECTRICALLY-DRIVEN HOISTS.

[COMMUNICATED.]

The central electricity stations which have now been established in all our large, and many of our smaller, towns have been built in the first instance for the supply of current for the purposes of private and public illumination; but as the hours in which much demand is made for current for such purposes are very restricted, and the standing charges at the station are the same whether the plant is working during the daytime or not, there is no wonder that the resident engineers and other officials connected with this department of municipal enterprise should not only ask for a day load, in the shape of a demand for current for motors, but should also do all that they can to procure this demand, and so decrease the cost per B.T.U. of the total output. In many cases the method adopted to create the required demand is to sing the praises of electricity as the source of the motive power for each and every requirement of the inhabitants of the town, but, while there are many cases in which the adoption of electrically-driven plant will be found more economical and efficient than the adoption of a steam, gas, or water-driven plant, there are other cases where the economy to be effected is not so apparent. Many prospective users thinking, and perhaps rightly, that the resident engineer has an axe of his own to grind in pressing the claims of electricity, have to carefully weigh from their own, or their neighbours', experience what will be the difference, not only in the first cost, but also in the cost of maintenance and running between the different sources of motive power; often they decide to keep to gas or steam, as they consider it advisable to deal with a motive power they think they know something about, in preference to one of which they willingly admit they are absolutely ignorant.

The question of the efficiency of an electrically-driven hoist as compared with that of an hydraulic hoist, or even one driven by a gas or steam engine has been lately much discussed, and the writer has often been asked for an authoritative opinion as to the best type to be adopted. An opportunity was recently afforded him of making a series of tests upon two hoists as follows:—

Figs. 1 and 2 show the elevation and plan of the gear for the first hoist tested. The hoist was designed to lift 1 ton 40 feet per minute, and the motive power was obtained from a motor, designed to run at 850 revolutions, with an input of 25 amperes at 220 volts = 5,500 watts, capable of developing 6·11 B.H.P. allowing 900 watts per B.H.P. or

of 6·47 B.H.P. if we allow 850 watts per B.H.P. As will be seen from the sketches, the power is transmitted through steel-cut gears to a second motion shaft, the motor pinion having 13 teeth with a pitch of 1½ inches, and the spur wheel 56 teeth, thus reducing the speed of the second motion shaft to 197·5 revolutions per minute. The diameter of both the driving and driven belt-pulleys was 24 inches, so that no further reduction in the speed was made here, and the power was transmitted by the usual open and crossed belts 4¼ inches wide to the fast and loose pulleys on the worm shaft. The worm wheel was made with 42 teeth having a 2-inch pitch; the wheel and worm were of unmachined cast-iron, the worm having a diameter over the thread of 8 inches and at the bottom of the thread of 5½ inches, the thickness of the thread was $\frac{15}{16}$ inch, the pitch 2 inches, and the angle of thread 5½°. The cage was lifted by a 2-inch rope and balanced by cast-iron weights sliding in grooves between the guide posts. The total travel of the cage was 35 feet 9 inches, and the cage was fitted with guide rollers top and bottom, these travelling on four wooden guide posts. Readings were taken of the current consumed, when only the second motion shaft was revolving, and also when the cage was being raised and lowered, both light and loaded; from these readings we obtain the table shown on page 1027.

From the above table it is seen that the balancing piece is of exactly the same weight as the cage, and that there is no overbalance to compensate for the average load to be raised or lowered. It would have been very inconvenient to have dismantled the gear and to have tested the efficiency of the motor alone, but from a series of tests made at different times upon exactly similar motors of the same size and make, the average efficiency of these motors was found to be at full load, when tested with a Soames brake, rather over 85 per cent. This shows that the assumption of 850 watts per B.H.P. is approximately correct, and taking the figures obtained by dividing the watts by this number, we find that in order to raise 20 cwt. 40 feet per minute, an operation which requires the theoretical expenditure of 2·715 B.H.P., the contractors instal a motor capable of developing 6·47 B.H.P., or in other words, anticipate certainly an efficiency of 41·9 per cent., or probably something higher, as a margin would be left for contingencies, or an occasional increased load; the power absorbed in friction, &c., when raising and lowering the empty cage is 3·111 B.H.P., and if to this is added the theoretical power required for hoisting 20 cwt., viz., 2·715 B.H.P., the total power required, provided the friction were not increased, would be 5·826, which is well within the power of the motor.

Upon examining the table we find that test No. 6 gives an

Fig. 1.

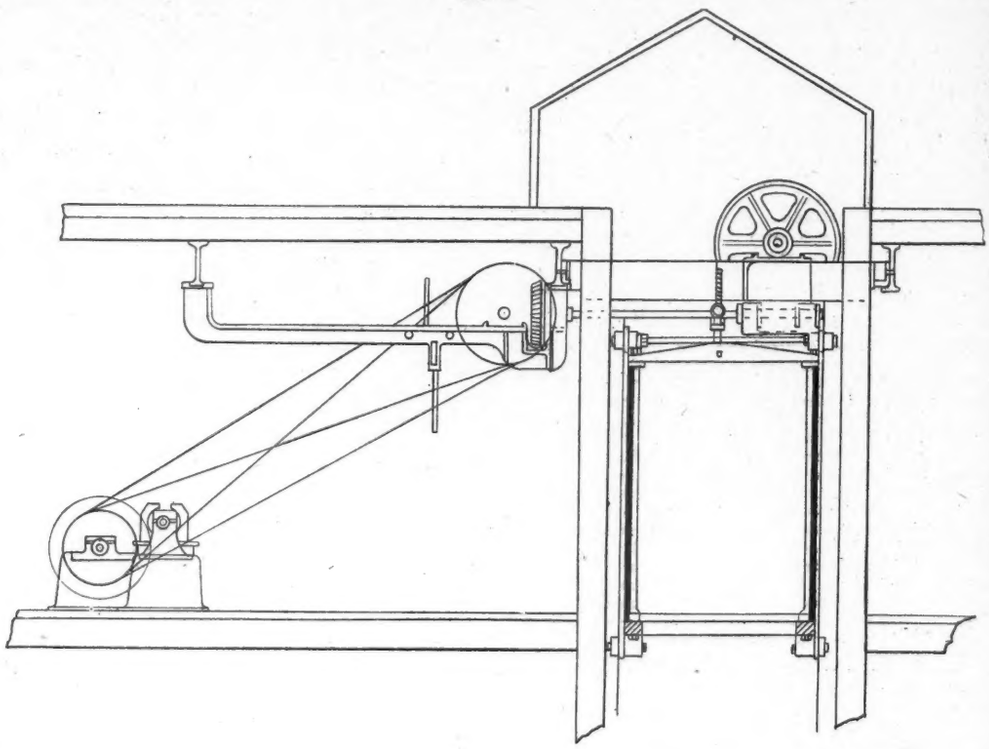
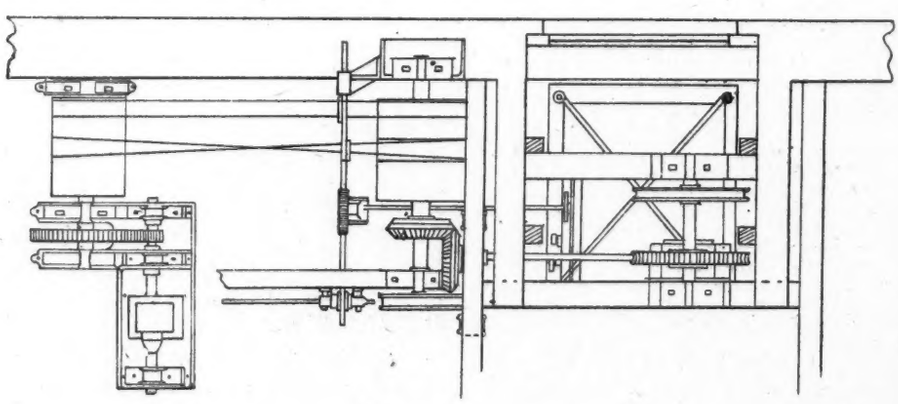


Fig. 2.



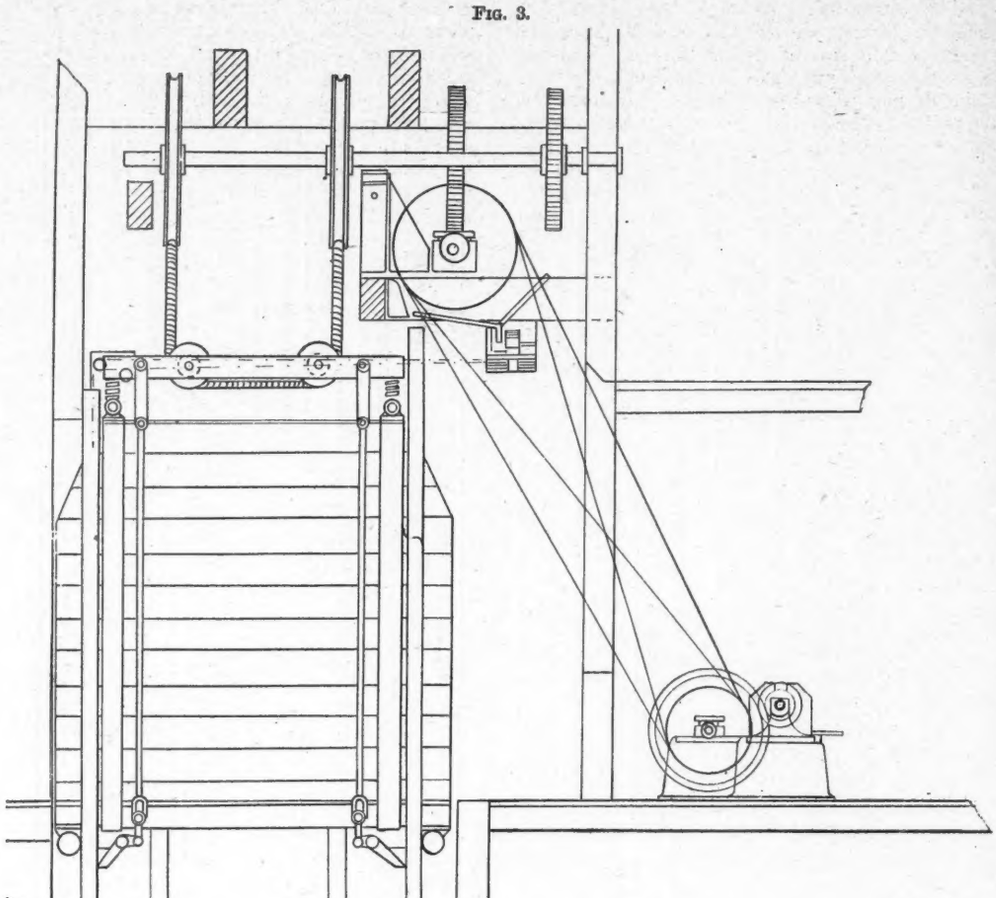
efficiency of 31·7 per cent. only, and test No. 9, 37·6 per cent., and that the power required to overcome the friction with the full load is largely in excess of that required for light loads. It will be further noticed that there is a considerable divergence between the readings of tests No. 6 and 9, and 7 and 8. All the tests were made very carefully, the electrical readings being obtained from Kelvin instruments, and an assistant was told off to take each separate reading, while in addition the owner and contractor were present, and both were perfectly satisfied that all the readings taken were absolutely correct. Tests Nos. 1 to 7 were first made, and after the figures were tabulated, the writer considered it advisable that further tests at full load should be made. This was done upon another day and after the hoist had been idle for some time, and this will probably account for the difference in the results. This will be more evident after considering

Number of test.	Work done.	Time occupied in travelling, 35' 9".	Speed of travel of cage in feet per minute.	Power consumed.			Power developed.			Theoretical horse-power to lift load in cage.	Power consumed at 900 watts per B.H.P. in overcoming friction.	Power consumed at 850 watts per B.H.P.	Percentage of efficiency in hoisting.		Proportion of the motor's maximum power being consumed in hoisting and friction.	Additional friction over and above that required by empty cage caused by loading cage 900 watts.	Ditto. 850 watts = B.H.P.
				Amperes.	Volts.	Watts.	Electrical horse-power, 746 watts = 1 E.H.P.	B.H.P. 900 watts.	B.H.P. 850 watts.				900 watts.	850 watts.			
With slow speed motion in gear :—																	
1	Motor driving itself :—Second motion shaft, 2 belts, and 2 loose pulleys.	...	...	11·0	222	2,442	3·273	2·713	2·873	...	2·713	2·873	...	...	·191		
2	Do. hoisting empty cage and moving worm shaft, worm wheel and speed reduction gear.	100 sec.	21·45	27	230	6,210	8·324	6·9	7·306	...	6·9	7·306	...	...	·486		
3	Do. lowering 1 empty cage.	100 sec.	21·45	26	230	5,980	8·016	6·644	7·035	...	6·644	7·035	...	...	·468		
4	Do. hoisting 40 cwt.	105 sec.	20·428	55	222	12,210	16·367	13·566	14·365	2·773	10·793	11·592	20·4 %	19·3 %	·956	3·893	4·286
5	Do. lowering 40 cwt.	105 sec.	20·428	35	224	7,840	10·509	8·711	9·223	...	8·711	9·223	...	...	·614		
6	Do. hoisting 70 cwt.	115 sec.	18·65	65	214	13,910	18·646	15·455	16·364	4·431	11·024	11·933	28·6 %	27·08%	1·09	4·124	4·627
7	Do. lowering 70 cwt.	105 sec.	20·428	30	224	6,720	9·008	7·466	7·906	...	7·466	7·906	...	...	·526		
With quick speed motion in gear :—																	
8	Motor same, &c., as No. 1 test.	...	...	15	222	3,330	4·463	3·7	3·913	...	3·7	3·913	...	...	·261		
9	Do. hoisting empty cage same as No. 2 test.	61 sec.	35·15	42	218	9,156	12·273	10·173	10·772	...	10·173	10·772	...	...	·717		
10	Do. lowering empty cage.	61 sec.	35·15	42·5	216	9,180	12·305	10·2	10·8	...	10·2	10·8	...	...	·719		
11	Do. hoisting 20 cwt.	62 sec.	34·59	59	214	1,626	16·924	14·028	14·854	2·348	11·68	12·506	16·73%	15·8 %	·989	1·507	1·734
12	Do. lowering 20 cwt.	61 sec.	35·15	42·5	222	9,435	12·647	10·483	11·1	...	10·483	11·1	...	...	·739		
13	Do. hoisting 40 cwt.	67 sec.	32·01	75	204	15,300	20·509	17·0	18·0	4·481	12·519	13·519	26·35%	24·89%	1·2	2·346	2·747
14	Do. lowering 40 cwt.	62 sec.	34·59	45	222	9,990	13·391	11·1	11·753	...	11·1	11·753	...	...	·783		
With slow speed motion in gear :—																	
15	Same as No. 7.	105 sec.	20·428	22	223	4,906	6·576	5·451	5·771	...	5·451	5·771	...	...	·382		
16	Same as No. 6.	115 sec.	18·65	62	212	13,144	17·618	14·604	15·463	4·431	10·173	11·032	30·3 %	28·7 %	1·03	3·529	3·626
17	Same as No. 15, but loaded unequally.	105 sec.	20·428	24	220	5,280	7·077	5·877	6·211	...	5·877	6·211	...	...	·414		
18	Same as No. 16, but loaded unequally.	114 sec.	18·815	72	218	15,696	21·040	17·44	18·465	4·466	12·974	13·992	25·7 %	23·9 %	1·24	6·330	6·686
With quick speed motion in gear :—																	
19	Same as No. 14.	61 sec.	35·15	45	225	10,125	13·572	11·250	11·911	...	11·250	11·911	...	...	·79		
20	Same as No. 13.	69 sec.	31·05	95	210	19,950	26·742	22·166	23·470	4·192	17·974	19·278	23·3 %	21·2 %	1·57	7·801	8·506

the tests made upon the larger hoist illustrated in figs. 3 and 4; the number of tests made upon this being greater and more varied.

From the sketches it will be seen that the two hoist gears are very similar in character, except that in order to obtain two speeds for the larger hoist, there are two pinions mounted upon the motor shaft and two spur wheels upon the second motion shaft, and also that there is an additional pair of wheels above the cage between the worm wheel and the rope pulleys. This hoist was designed to lift 40 cwt. 35 feet per minute, or 70 cwt. 20 feet per minute. The motive power was obtained from a motor designed to run at 750 revolutions per minute, with an input of 58 amperes at 220 volts = 12,750 watts, capable of developing 14·177 B.H.P., allowing 900 watts per B.H.P., or 15·012 B.H.P., allowing 850 watts per B.H.P. As will be seen, the power is

Fig. 3.



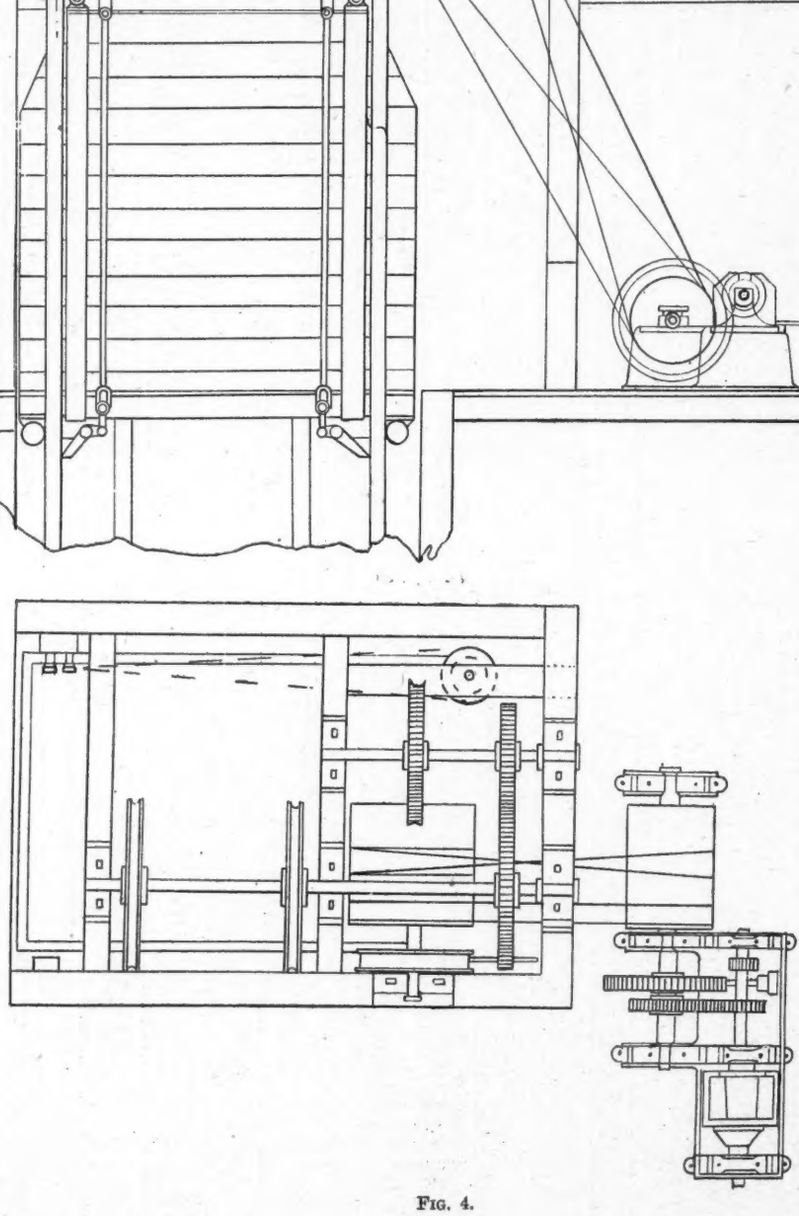


Fig. 4.

transmitted through steel-cut wheels to a second motion shaft, the slow speed motor pinion having 13 teeth and the corresponding spur wheel 65 teeth with a pitch of 1⅝ inches, thus reducing the speed of the second motion shaft to 150 revolutions per minute, and the quick speed motor pinion having 20 teeth and the corresponding pinion 57 teeth with a pitch of 1⅝ inches as before, reducing the speed of the second motion shaft to 265 revolutions per minute. A further reduction in the speed was made in this case at the worm shaft, as the driving pulley was 38 inches in diameter and the driven pulley 20 inches diameter. The power is transmitted to the usual fast and loose pulleys by means of open and crossed belts 5½ inches wide, the speeds of the worm shaft being respectively 80 revolutions per minute and 140 revolutions per minute, according as the fast or slow speed pinion is in gear. The worm wheel was made with 66 teeth having a pitch of 2¼ inches; this and the worm were made of unmachined cast-iron, the worm having a diameter over the thread of 10½ inches and at the bottom of the thread a diameter of 7½ inches, the thickness of the thread was 1⅛ inches, the pitch 2¼ inches, and the angle of the thread 4½°. The overhead pair of wheels still further reduced the speed, the pinion having 21 teeth and the spur wheel 56 teeth, with a pitch of 2¼ inches. The cage was lifted by two 2-inch ropes and balanced by means of a cast-iron weight sliding in a groove between the guide posts; the cage was fitted with guide pulleys top and bottom, which ran on four wooden guide posts, and the cage travelled through a height of 35 feet 9 inches.

Readings of the current consumed were taken when the motor, second motion shaft and loose pulleys only were revolving, both with the quick and slow speed pinions in gear, and also with the cage running at light, half, and full load; tests were also made with the cage unequally loaded, the weights being placed one-third out of the centre. The same instruments were used and the same methods adopted as in the case of the smaller hoist; the tests numbered 1 to 14 were all taken on one day, and the last six on a later day. Upon each date the owner and the contractor were present, and both were perfectly satisfied as to the accuracy of all the readings; the amperes consumed varied in many of the tests, but the figures given are the average readings for each particular test. All times were taken by means of stop watches. From these tests the table on p. 1025 was obtained. The contractor had stated in his specification that the motors should develop 1 B.H.P. with an input of 900 watts, but as exhaustive tests upon similar sizes of motors have shown that 850 watts is a more correct figure, although this is a little high for the larger motor, two columns of B.H.P. are given, one in accordance with what the contractor guaranteed, and the other in accordance with the actual tests.

slightly heavier than the balance weight, while tests 9 and 10 would show that the cage was rather lighter than the weight; it was impossible to have the two weighed, but in all probability the former readings more correctly show the difference in the balance. The efficiency varies from 21 per cent. to 28·7 per cent. with full load, and as the theoretical power required is 4·754 B.H.P. and the contractors intended in the first instance to instal a 10 B.H.P. motor, they evidently anticipated obtaining an efficiency of 42 per cent.; the larger size motor was put in at the wish of the owner, who intended using the surplus power for another purpose, but as will be noted from tests Nos. 5, 13, 16, 18 and 20, not only is there no surplus power, but even the power the larger motor is rated to give out is exceeded. The tests 15 to 20 were conducted in the first instance in order to discover what difference, if any, was made if the cage were unequally balanced, as there was some doubt as to whether sufficient care had been exercised when loading the cage for the previous tests, and consequently it was thought that possibly a large amount of the increased friction might be due to the cage pressing unduly against one set of guides. For tests 15 and 16 the utmost care was taken in seeing that the weight was uniformly distributed, while for tests 17 and 18 the centre of gravity of the load was halfway between the centre of the cage floor and one side; this resulted in the floor level of the cage being tilted to an amount of 5 inches, and while practically 3 B.H.P. more were required to raise the cage when loaded unequally than when loaded equally, these tests showed that the load had not been very unequally distributed during the former tests.

It was intended to make tests with the cage equally and unequally loaded when the quick speed motion was in gear, and tests Nos. 19 and 20 were actually made for this purpose, when it was considered useless to proceed; during the time that these tests were in progress other observations were being made, and it was noted that the case over the worm and wheel was rapidly growing warmer, until after the high readings obtained for test No. 20 the worm itself was examined and found to have attained an excessively high temperature. This was apparently the source of all the trouble, as tests Nos. 14 and 15, made when everything was cool, gave readings much lower than similar tests, Nos. 6 and 7, made when the hoist had been running for some time; and while test No. 19 is comparable with test No. 14, test No. 20 is considerably higher than test No. 13. When all these tests were made the hoist had been working for some time, but probably longer on the second occasion than on the first, as several runs were made in order to secure a mean reading, and yet it was known that the load was equally distributed for test No. 20, whereas there was some doubt of its being so when test No. 13 was made. So that there could be very little in the theory of unequal distribution, while the

Number of test.	Work done.	Time occupied in travelling, 35′ 9″.	Speed of travel of cage in feet per minute.	Power consumed.			Power developed.			Theoretical H.P. required to lift load in cage.	Power consumed at 900 watts per B.H.P. in overcoming friction.	Ditto at 850 watts per B.H.P.	Percentage of efficiency in hoisting.		Proportion of the motor's maximum power being consumed in friction and hoisting.	Additional friction over and above that required by empty cage caused by loading cage, 900 watts per B.H.P.	Ditto. 850 watts per B.H.P.
				Amps.	Volts.	Watts	Electrical H.P. 746 watts.	B.H.P. 900 watts.	B.H.P. 850 watts.				850 watts = B.H.P.	900 watts = B.H.P.			
1	Motor driving itself, second motion shaft, two belts and two loose pulleys.	...	...	5	220	1,100	1·474	1·2	1·294	...	1·2	1·294	nil	...	·2		
2	Ditto with worm and shaft, worm wheel, rope pulley, and shaft and lifting cage empty.	55 sec.	39·0	11·5	230	2,645	3·534	2·938	3·111	...	2·938	3·111	nil	...	·481		
3	Ditto, lowering cage empty.	55 sec.	39·0	11·5	230	2,645	3·534	2·938	3·111	...	2·938	3·111	nil	...	·481		
4	Ditto hoisting 11¼ cwt.	56 sec.	38·3	23	230	5,290	7·091	5·87	6·223	1·082	4·788	5·141	18·4%	17·3%	·961	1·850	2·030
5	Ditto lowering 11¼ cwt.	54 sec.	39·72	9·5	230	2,185	2·928	2·427	2·57	...	2·427	2·57	...	...	·397		
6	Ditto hoisting 20 cwt.	59 sec.	36·35	30	220	6,600	8·847	7·3	7·765	2·467	4·866	5·298	33·6%	31·7%	1·2	1·928	2·187
7	Ditto lowering 20 cwt.	55 sec.	39·0	10	220	2,200	2·949	2·4	2·588	...	2·4	2·588	...	...	·4		
8	Same as No. 7... ...	55½ sec.	39·0	8·5	225	1,912	2·563	2·125	2·250	...	2·125	2·250	...	...	·287		
9	Same as No. 6... ...	60 sec.	36	25	221	5,525	7·406	6·139	6·529	2·467	3·672	4·062	39 %	37·6%	1·05	·734	·951

Upon examining this table it will be noticed that, judging from tests 2 and 3, it would appear as though the cage was fact of the hot gear was absolutely proved. After this, tests Nos. 8 and 9 were made with the smaller hoist, to see if the

gear got unduly hot, and after one or two journeys up and down of the cage, this was found to be the case, and further experiments were abandoned.

Before the writer was called in to report upon the hoists, considerable complaint had been made, and it appeared that the hoists had in the first place been fitted with machined steel worm and wheels, but that to improve the working the contractor had replaced these with the unmachined cast-iron ones, why, the writer could not learn, but probably, either because the speeds were wrong, or else because a better angle of worm thread was considered advisable. The motor and second motion shaft pinions and spur wheels created a very great amount of noise, while the teeth were of a bad design, and would, when running, emit sparks; also the reduction spur wheels above the larger hoist were too far in gear, and did not run at all smoothly.

After this experience, it would not be surprising if the purchaser were to be strongly opposed in the future to all forms of electrical driving, more especially as these hoists were erected to take the place of existing hydraulic hoists; but the writer does not consider that the fault lies with the use of electricity, but rather with its application. If electricity is used, in order to obtain a fair comparison, the gear employed should be at least equal to that which would be used were steam or gas employed as the source of motive power, or rather, it should be better, as we are dealing with reduction from a higher number of revolutions, and there is no doubt, judging from tests 1, 2 and 3, made on each hoist, that if the gear were thoroughly overhauled, steel machine-cut wheels substituted for the present ones, and all other sources of unnecessary waste of power eliminated, the hoists could be run with an efficiency of 42 per cent., or perhaps rather higher as originally anticipated. Another question which arises is, do hoists which are steam or gas-driven give better or as good efficiencies? With motor driving it is an easy matter to obtain actual results by inserting reliable instruments, whereas when gas or steam is employed to obtain a true record from moment to moment, a considerably longer time would have to be taken for the tests and the expense would be proportionately greater: probably many hoists so driven exist to-day with lower efficiencies than those recorded above, and have been accepted on the makers' word without having been tested, and it is more than likely that the makers themselves would be astonished if they knew what the efficiencies really were.

The writer would make one suggestion to the makers of electrical hoists, viz., that the use of high speed motors should be abandoned, and that in place of spending money on reducing gear, it would be better spent in paying the increased cost for a motor running at 250 to 400 revolutions per minute, instead of running at something between 750 and 1,000 revolutions per minute.

It might be added that the motor speeds were also recorded during the various tests, and that there was very little slipping of the belts, but that the variation in the speed shown in the third column had its origin almost entirely in variation in the motor speed. This is only what would be anticipated if attention were paid to the variation in the electromotive force, which fluctuated from 204 to 230 volts, as well as to the fact that the motors were shunt-wound, and that the input in amperes varied greatly.

LONDON COMPANIES AND THE CHANGE IN PRESSURE FROM 110 TO 200 VOLTS.

The London electric supply companies and local authorities owning electricity supply undertakings, who, some time ago, approached the President of the Board of Trade with a view to an alteration in the proviso to Clause 6, Section B, of the Board of Trade regulations of March 4th, 1896, intend to make a further application in order, if possible, to accomplish the object in question. When the representatives of the companies and local authorities appeared as a deputation, the President of the Board reserved his decision on the question, pending further information being placed before

ce that time the companies have been in negotiation with each other and with the local authorities interested in the question, and the following is the substance of the draft letter which it is proposed to forward to the President of the Board of Trade for consideration :—

In accordance with this permission, we have the honour to submit the following general points for your consideration. Letters from some of the undertakers, giving in greater detail answers to points on which you desired fuller information, will be separately addressed to you, and we are informed by the Metropolitan Electric Supply Company that they have already submitted their views to you in response to your invitation at the interview.

Some of the companies and local authorities have, under the existing regulations, already given notice to their consumers of the change of voltage, and at the same time have offered facilities and assistance as compensation for any expense to which the consumer may be put. Others contemplate giving such notice.

In most cases such facilities, or assistance, have proved sufficient, but there remains a certain number of consumers to whom the question of terms does not appeal, and who refuse on any conditions to agree to the change.

In consequence of this, in some cases the completion of the change has had to be postponed, or has been brought to a deadlock, but in others, owing to local and special circumstances, it has not yet reached that critical point.

In any case, it is clear that one individual consumer (no matter how large or how small his consumption) can absolutely prevent the completion of a change of pressure over a whole district of the metropolis.

The doubling of the pressure of supply now being generally carried out has for its object an increase in the number of lamps which can be supplied from the same mains. From this results:—

1. The avoidance of so frequently disturbing the streets for the purpose of increasing the capacity of existing mains.

2. A better service to consumers generally by giving more equable voltage, and a means of lowering the price on account of more economical distribution.

3. A saving to the undertakers.

The matter is of considerable consequence to the local authority, both because of the lessening of disturbance of the streets, which more or less affects all London (except those areas where the pressure has been started at 200 volts), and in view of the possible purchase of the undertakings of supply companies by the local authorities, it is desirable that the capital expenditure should be kept as low as possible.

We submit that an increase in the pressure is thus desirable from the point of view of both the local authority and of consumers, and that it is unreasonable it should be in the power of a few individuals to delay or prevent an improvement in the method of supply.

With regard to (3), we desire to state that the immediate saving is no more than that effected in distribution losses, and that the saving in capital outlay is on mains to meet future demands.

The undertakers point out that any saving in revenue thereby made is less than the reductions they are in general making in the rate charged to consumers supplied at the higher pressure; in other words, that the probable saving in revenue has been or is being discounted by the reduction of rates. The profits to be gained will arise from the increase of business which the change renders possible.

Such an alteration in the Regulations as we desire would in practice affect only a few individuals, and would not deprive consumers of any right except such as has been given them by the issue of the Regulation in question.

We further submit:—

That this regulation, without any provision for appeal, leaves it entirely in the hands of certain consumers to, at least, put undertakers to heavy additional expense, notwithstanding that appeal is allowed if the County Council refuse their consent to the change or impose too onerous conditions, and—

2. That the principle of arbitration is allowed in practically every other case under the provisional orders where difficulties arise between the undertakers and public authorities, or individuals, as well as between the undertakers and their consumers.

We hope on consideration that, as the interests of consumers would be amply safeguarded, you will be able to consent to an alteration of the Regulation in question such as we have suggested, viz., that for the words, "with the consent of the consumer," in the concluding part of the proviso to Clause 6, Section B of the Board of Trade Regulations, 1896, there should be substituted the words, "*on such terms and conditions as may be agreed upon between the undertakers and the consumer, or failing agreement as may be settled by an arbitrator appointed by the Board of Trade*," or words to this effect.

Bournemouth.—An inquiry was held last week into the application of the T.C. for sanction to borrow £12,000 for purposes of electric lighting, by Mr. Percy Boulnois, M.Inst.C.E., an inspector of the L.G.B. The town clerk stated that it was the intention of the Corporation to utilise electricity for working the trams and to light the main roads. The amount applied for included all the necessary plant and apparatus for 220 arc lamps at distances of 60 to 80 yards apart, extending over seven or eight miles of public roads. The scheme was explained by Mr. E. M. Lacey, of Messrs. Lacey, Clirehugh & Sillar, consulting electrical engineers to the Corporation. There was no opposition.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Dec. 19th, 1899.		Week ending Dec. 18th, 1900.	
Adelaide	£130	Alexandria	£70
Alexandria	140	,, Teleph. mat.	92
Amsterdam	60	Amsterdam	40
Auckland	100	Bangkok	64
Bahia. Teleg. instruments	57	Buenos Ayres	942
Bombay	103	,, Teleg. wire	644
Bordeaux	32	Calcutta	546
Boston	25	Cape Town	168
Boulogne	34	,, Teleg. mat.	1,967
Bremen	22	Colombo	147
Buenos Ayres	1,214	Copenhagen. Teleg. cable	228
Calcutta	201	Durban	752
Cape Town	85	East London. Teleg. mat.	555
Chinde. Teleg. mat.	86	Fremantle	875
Christiania. Teleg. cable	458	Gibraltar. Teleg. mat.	50
Colombo.	951	Halifax	26
Durban	28	Hamburg. Teleg. mat.	500
Gibraltar	31	Hong Kong	1,087
Halifax. Teleg. apparatus	2,500	Liban. Teleg. apparatus	940
Hamburg	80	Melbourne	75
,, Teleg. mat.	200	,, Teleg. mat.	909
Hong Kong	15	Odessa. Teleg. mat.	200
Launceston	37	Ostend	442
Madeira	43	Otago	46
Madras	116	Port Elizabeth	38
Malta. Teleg. cable	13,680	Port Said	21
Melbourne	162	Rangoon	475
Ostend	85	Rio Janeiro	36
Port Chalmers. Teleg. mat.	200	,, Teleg. mat.	568
Port Elizabeth	19	Rosario	577
Rangoon	160	,, Teleg. mat.	309
Santandat	90	Santos	417
St. Lucia	21	Shanghai	236
Stockholm	28	Singapore	315
Sydney	1,193	Stockholm. Teleg. mat.	232
Tokio. Teleg. cable	73	Sydney	822
Yokohama	143	,, Teleg. mat.	1,733
		Wellington	51
		Yokohama	30
Total	£22,407	Total	£16,660

Foreign Goods Transhipped.

Barbadoes. Teleph. appar. Value £1

Electrical Wares Exported.

Week ending Dec. 26th, 1899.		Week ending Dec. 25th, 1900.	
Albany	£15	Adelaide	£22
Alexandria	29	Alexandria	64
Amsterdam	33	Amsterdam	55
Bombay	66	Bangkok	100
,, Teleg. wire	80	Buenos Ayres	189
Boulogne	50	Calcutta	919
Bremen	63	,, Teleg. mat.	45
Brisbane Teleg. mat.	57	,, Teleg. wire	167
Brussels	124	Cape Town	179
Buenos Ayres	1,150	Demerara. Teleg. mat.	720
,, Teleg. wire	634	Durban	61
Calcutta	648	,, Teleph. mat.	99
Chinde. Teleg. mat.	64	Fremantle	1,349
Christiania. Teleg. wire	236	Gibraltar. Teleg. mat.	19
Colombo. Teleg. mat.	278	Hong Kong. Teleg. cable	83
Copenhagen. Teleg. wire	95	Kure. Teleg. cable	5,458
,, Telephones	38	Melbourne	1,248
Durban	1,156	Nagasaki	22
,, Teleg. mat.	79	Ostend	194
Havre	90	Paris	16
Hong Kong	608	Perth	188
Launceston. Elec. motor	120	Port Elizabeth	76
Madras	95	Reval	151
Malta	27	Rotterdam. Teleg. wire	23
Marseilles. Teleg. cable	694	Rouen	85
Melbourne	264	Santa Cruz	79
,, Teleg. mat.	1,037	Shanghai	152
Montreal	96	Singapore	610
Perth	44	Sydney	2,316
Port Elizabeth	68	Wanganui	80
,, Teleg. cable	871	Yokohama	106
Shanghai	578		
Stockholm. Teleg. mat.	557		
Sydney	886		
,, Electric detonators	70		
,, Teleg. mat.	98		
Wellington	763		
Total	£11,281	Total	£15,272

Foreign Goods Transhipped.

Bombay. Elec. goods	£87	Gothenburg. Telephones	£12
Durban. Teleph. mat.	449	Melbourne. Teleph. appts.	45
Hong Kong. Elec. light appts.	263		
Total	£799	Total	£57

Books Received.—"Fortschritte der Elektrotechnik," by Dr. Karl Kahle. Berlin: Julius Springer, 1900.

Science Abstracts, December 26th, 1900. London: E. and F. N. Spon, Limited. 2s.

Catalogues and Lists.—The Consolidated Telpherage Company, of New York, sends us a couple of lists describing its electrical aerial cableways.

The Westinghouse Company's list, No. 1,036, is devoted to "belt-driven single-phase alternators."

Messrs. Entwistle & Stephens, Limited, of Gray's Inn Road, have sent us a copy of their last list of shades and holders for electric light. The effect obtained from some of those illustrated must be very pleasing.

The Sun Fan Company, Limited, of Bradford, recently issued a new list of ventilating fans for belt or rope driving, and also for electric driving with the motor connected to the fan shaft. The list also contains particulars of their special steam heater for drying and other purposes.

Circular No. 1,033, received from the Westinghouse Companies' publishing department, describes their direct-current engine type generators for 125 volts.

Messrs. Blackstone & Co., Limited, of Rutland Works, Stamford, recently issued lists relating to their manufactures. These describe the Blackstone oil engines, showing the various parts, and give prices, dimensions, &c. This engine seems to have come out of some trials made last year under the auspices of the Highland and Agricultural Society of Scotland, with conspicuous success. Another list deals with the "Stamford" grinding and kibbling mills, and a third with steam engines and boilers.

Mr. Peter Burns, of Elm Park, Liverpool, has sent us a circular of the new London dry seat for tramcar tops and other outside use.

From Mr. F. Winter, of Redcross Street, E.C., the sole agent in the United Kingdom for the Harburg India-Rubber Company, of Hamburg and Harburg, we have received a list giving a few illustrations of insulators and fittings for overhead tramway lines. Their long experience in the manufacture of vulcanite (ebonite) has enabled them to produce a special quality for this kind of work. It is claimed to possess all the high insulating power of vulcanite, but by adding suitable ingredients it has been made harder and tougher than the ordinary qualities, rendered impervious to water and weather, and made capable of resisting enormous strains. As they have been supplying insulating parts for electric tramways for many years past the Harburg Company claim that they are not new to the requirements of electric traction work.

Messrs. Reavell & Co., Limited, of Ipswich, have recently sent us a copy of their new catalogue of air compressors and hoists. The compressors are manufactured under their own patents, and are of the high speed type, especially designed to work quietly at a fairly high speed of revolution, and to give a continuous supply of air, so as to reduce the size of the reservoirs which at present are used with pneumatic equipments. The compressors are designed for belt or electric driving, and can also be driven by steam engines. They are suited for supplying compressed air at 80 to 100 lbs. pressure, for working all types of pneumatic tools in workshops; and the electrically-driven type is eminently adapted for colliery and quarry work where compressed air is in use for rock drilling, &c. The list, which is illustrated with sectional and other drawings, gives particulars of sizes and prices.

The Consolidated Telephone Construction and Manufacturing Company, Limited, has issued several sheets relating to high tension positive break switches, the "Consolidated" inter-communication system, and other of their specialities of English manufacture.

Mr. Edward Lansing, the European manager for "Smith, of New York," sends us a copy of his catalogue of head-lights, railroad car and signal lamps, lanterns, reflectors and general supplies. There are some very neat designs shown for lighting electric cars.

Messrs. L. and C. Steinmüller, of Gummersbach, Rheinprovinz, send us an illustrated catalogue and lists of their "Steinmüller" water-tube boiler and superheater. These boilers are constructed for from 6 to 20 atmospheres pressure, and for a variety of conditions, such as space, capacity, fuel, &c., and from 10 to 500 square meters heating surface. The boiler is stated to give under normal working, and favourable conditions, a supply of 15 to 20 kg. of dry steam per square meter of heating surface per hour. Since its introduction 25 years ago, the Steinmüller boiler has been largely adopted on the Continent, and more than 1,000,000 H.P. has been supplied. This includes a number of Continental electrical manufactories. Simplicity, sure working and economy of fuel are claimed as its special features. At the last Berlin Industrial Exhibition the boiler secured the diploma of honour for service rendered in perfecting the water-tube boiler, and also the silver medal for prominent industrial services. Other awards has been obtained at other exhibitions. The firm have taken up the manufacture of their patent superheaters on a large scale.

Messrs. Alfred Dougill & Co., Limited, of Great George Street, Leeds, send us a copy of their Section D list, in which their patent gas engine for powers of 25-horse and upwards is described. Another circular relates to the "Tornado" improved patent air propeller, while yet others give testimonials and a few general particulars relating to their gas and oil engines.

The Newton Electrical Works, Limited, of Taunton, has brought out an excellent 1901 catalogue of the "Taunton" dynamos and motors. A thick enamelled paper and first class blocks, together with good arrangement of letterpress, all combine to produce an excellent illustrative effect. "Taunton" tramway generators, four and two-pole dynamos, direct coupled sets for ship and other lighting and power work, motor-generators, enclosed motors, electric winding and haulage machines, launch motors, automatic switches, central station switchboards and motor starting switches are among the contents. The prices, &c., are tabulated on several pages at the end of the book.

Messrs. Laurence, Scott & Co., Limited, of Norwich, have published a set of illustrations of their dynamos and motors, and the arrangement is such that new lists may be added without difficulty. This firm has continuously employed the slotted drum armature ever since it began making electrical machinery 17 years ago, and it makes a speciality of barrel winding. Numerous first class process and line illustrations show generators and parts, a group of electrical fans for H.M.S. *Irresistible*, enclosed motors, rope-driven and other generators. The Gothic Works are equipped with the most modern machinery for turning out dynamos and motors most satisfactorily, and the firm's staff has fitted motors into all sorts of factories, in one instance having lately supplied to one firm no less than 160 motors ranging from 5 to 20-H.P.

A number of lists are before us from Messrs. Hawksley, Wild and Co., of Brightside Boiler Works, Sheffield. They deal respectively with the firm's patent flanged flued steel boilers, Hawksley's

diagonal grate bars, improved expansion water heaters, patent filters, and steam jet and hot air distributors. Sectional drawings show the principle of each of the specialities.

In a pamphlet just issued the Holland House Electrical Manufacturing Company, Limited, of Glasgow, have reprinted from the ELECTRICAL REVIEW a description of the feeder switchboard apparatus made by them for the Glasgow Corporation.

The British Thomson-Houston Company's pamphlet No. 81 deals with incandescent lamps and incandescent lighting. A number of excellent little illustrations show how admirably this system of electric lighting lends itself to the production of artistic effects for both inside and outside illumination. Some very pretty fittings are shown.

Liquidation. — Creditors of the Manchester Electrical Works, Limited, are to send particulars of debts, &c., to J. Fitzpatrick, the liquidator, at 147, Leadenhall Street, E.C., by February 1st.

Mine Lighting from Water Power.—The Collingwood Gold Fields, Limited, will, in all probability, shortly make use of their splendid water power for lighting their extensive workings at Golden Bay, New Zealand. The water, which is derived from a lake, and is in practically unlimited quantities, is under a head of 200 feet. Pelton wheels are to be used. Messrs. Adams and Williams, the consulting engineers, are reporting to the company on the matter, Mr. Williams having spent some time in the Colony.

Smart Work by English Manufacturers. — On November 28th last the Sheffield Corporation, acting on the advice of their chief engineer and manager, Mr. S. E. Fedden, decided to purchase one of Parsons steam turbo-alternators, to help them over the Christmas load, and the order was, therefore, sent off by telegram to Paris, where the machine was still standing as it had been through the Exhibition. It was immediately taken down, packed, and despatched to Sheffield, and on the date of writing, namely, December 21st, 1900, it was running with 200 amperes at about 12 o'clock noon. This machine was no light weight to be taken by passenger train, as it weighed some 14 tons, and was of the 500 KW. capacity type. The 16-inch exhaust mains and steel rivetted steam mains were ordered as soon as the drawings could be made out, and were delivered in about 17 days. When they came to be erected with the turbine they were found to fit accurately. The steam and exhaust piping was supplied by Messrs. Tasker's Engineering Co., of Sheffield, and great credit is considered to be due to both firms for the smart and able way in which the whole of the work referred to has been carried out.

Summons.—In the Liverpool City Police Court on Friday, before Messrs. J. Roxburgh and E. Lloyd, Edwin Isherwood, electrical engineer and contractor, 19, South John St., was summoned by the Corporation of Liverpool for having fraudulently abstracted electricity from the Corporation supply.—Mr. Pierce, deputy town clerk, who prosecuted, stated that it had been observed in the early part of the year that the quantity of electricity used by defendant was not so great as would be expected when the number of lights on the premises were taken into consideration. The meter was examined, but was found to be in order. Inquiries were made, and it was concluded that defendant had been abstracting the current by placing a wire to the pipe supplying the meter and carrying the wire away from the meter. By that means the electric current was diverted from the meter, and was not registered. —Albert Addison Lake, a youth in the employ of the defendant from March to November, stated that he saw Isherwood tampering with the electrical appliances, and connect a piece of wire so as to take the current away from the meter. Further, that Isherwood had complained to him that the meter registered too much, or that the Corporation charged too much, and that he did not think there was anything wrong in taking it out of them.—Alfred Clough, assistant electrical engineer under the Corporation, gave evidence as to examining the meter, and being led to suspect that the quantity of electricity registered as consumed was not correct.—For the defence, Mr. W. H. Quilliam contended that the witness Lake was a discharged servant of defendant's, and that he had concocted his story of tampering with the meter for spite.—Defendant was sworn and denied that he had used the method spoken of to defraud the Corporation.—A youth who had been in his employ was called, and deposed that he had never seen defendant using a wire at the meter as stated.—After considering the evidence, the magistrates were equally divided in their opinion of the case. It was therefore adjourned for 14 days that a third magistrate might be present.

Trade Announcements.—The following companies have removed their offices to 27 and 28, Broad Street Avenue, E.C.:—The Pioneer Electric Light and Power Company of China, Limited; the British Pioneer Electric Light and Power Company of India, Limited; the Pioneer Electric Light and Power Company of Japan, Limited; the Adelaide Electric Tramways Company, Limited; the New Zealand Electric Light and Traction Company, Limited.

The New Zealand Electrical Syndicate has removed its offices to New Broad Street House, New Broad Street, E.C.

We are informed that the combined businesses of Laing, Wharton & Down, Limited (acquired from the Receiver) and J. S. Cunnington and Co. will henceforth be carried on by Messrs. J. S. Cunnington and H. King Smith at 93, St. Martin's Lane, W.C., under the style of Laing, Wharton & Cunnington.

In consequence of greatly increased business, Messrs. Doherty and Donat have removed from South King Street, Manchester, to larger premises at 82 and 83, Deansgate Arcade, Deansgate, Manchester. The firm makes specialities of cooling and condensing plants, pumping machinery for all purposes, fans for ventilation and blowing, and modern plant for chemical works.

Mr. P. L. Dwyer having severed his connection with Sax, Slatter and Co., Limited, of Forester's Hall, Clerkenwell, has joined Julius Sax & Co., Limited, of 119, Coldharbour Lane, S.E., and from January 1st, 1901, will represent them as "London traveller."

Mr. F. J. Jones has purchased the business of the late Messrs. F. J. Jones & Co., Limited, of Teller Street Electrical Works, Chester.

ELECTRIC LIGHT AND POWER NOTES.

Aldershot.—The T.C. has accepted the tender of Messrs. Thos. Parker for the equipment of an electricity works at £14,466, and has resolved to apply to the L.G.B. for leave to borrow £20,000. Messrs. Parker are to work the installation for six months and to continue to do so for 2½ years longer if required.

Aylesbury.—The U.D.C. has decided to apply to the B. of T. for an extension of time under its provisional order, and in the meantime will treat for the purchase of land, and ascertain what companies are willing to compete.

Coventry.—The City Council has decided to adopt the following scale of charges for electrical energy used for the supply of motors:—Up to 100 units per quarter per kilowatt demanded, 6d. per unit; beyond that amount, 1d. per unit.

Derbyshire and Nottinghamshire.—A Bill has been deposited in the Private Bill Office of the House of Commons to incorporate and confer powers on a company to be known as "The Derbyshire and Nottinghamshire Electric Power Company." According to the *Nottingham Guardian*, the company is to be established for the purpose of "producing and supplying electrical energy" within the whole of the county of Nottingham and the county of Derbyshire which lies to the south of the River Trent, and to the north-west of the boundary between the Unions of Bakewell and Chapel-en-le-Frith. The share and loan capital of the proposed company is fixed at £2,400,000, of which £600,000 may be raised by the issue of debenture stock, and £1,800,000 by the issue of £1 shares, but with the right to divide these shares into "preferred half shares" and "deferred half shares." The company ask for powers to proceed to acquire the lands authorised to be taken under this Bill as soon as £100,000 "of the capital of the company shall have been subscribed under contract binding the parties." The promoters named in the Bill are Sir E. H. Carbutt, Bart., Mr. F. Faithfull Begg, Mr. F. Carver, Mr. F. Clench, Mr. Duke Fox, Mr. Archibald Grove, Mr. M. H. Mills, Mr. W. O. Plowright and Mr. J. W. Thackerey.

Dublin.—Mr. J. W. Drury, the L.G.B. auditor, has surcharged the members of the Electric Lighting Committee in respect of certain payments made in connection with the supply of electric light fittings to consumers, &c., to the amount of £2,000. The bulk of this sum was expended upon alterations and the construction of a new switchboard at the Fleet Street electric station, some £400 only being set down against the cost of fittings put up upon consumers' premises. But £400 does not cover the cost of electric fittings, and should the present surcharge be upheld, it is very probable that another surcharge of £3,000 will be made at next audit.

Faversham.—At a meeting of the T.C. last week it was decided to erect a generating station with a capacity of supplying 5,000 8-C.P. lamps, and to apply to the L.G.B. for leave to spend £20,000 on the undertaking. The consulting engineer, Mr. Talbot, had advised the adoption of the direct-current three-wire system.

Glasgow.—An explosion, caused, it is surmised, by an accumulation of gas from sewers and gas pipes, occurred in one of the street service junction boxes in Waterloo Street last week. The damage was quickly repaired.

At a meeting of the Council last week the question of a Corporation insurance department was again under discussion, so far as it referred to the electricity department. After some discussion, it was decided on Bailie Maclay's motion that only two-fifths of the electrical department's risks should be undertaken by this new department. It was stated that the property of the electrical department at present insured only amounted to £170,000.

Gourock.—At a meeting the Burgh Commissioners last week the Commission resolved to make application to the B. of T. for an electric lighting prov. order. Messrs. Burstall & Monkhouse have been appointed consulting engineers.

Greenock.—At the monthly meeting of the Police Board it was stated that the electrical engineer, Mr. Nelson, had reported the necessity for an increase in the generating plant before next autumn. He estimated the cost of a 300-KW. steam dynamo at £3,300, and stated that it would be necessary to have the plant ordered before the end of the year. Reference was made to the Parliamentary notice by the Caledonian Electric Power Company of their intention to supply electric energy within the county of Renfrew and burghs therein, and it was agreed to recommend that the application of this company should be opposed, and that the sub-committee on electricity should take whatever steps are necessary to protect the interests of the Board.

Greenock.—The Town Council is negotiating with the authorities at Gourock and Port Glasgow with a view to supplying these districts with current for lighting and power purposes at a reasonable figure.

Lancaster.—In view of the fact that the Corporation has obtained Parliamentary sanction to an electric tramway scheme to cost £80,000, the T.C. naturally is of opinion that it will be necessary to pay a decent salary and get a capable man to superintend the construction of the tramways, besides keeping an eye upon the electrical works. The electrical engineer, Mr. W. A. Fraser, is serving with the Middlesex Yeomanry in South Africa, and the Corporation promised to keep his place open. For 12 months the work has been done by an assistant (Mr. Frost) under the nominal supervision of the borough engineer, Mr. J. Cook. Now Mr. Frost has accepted a better appointment at Darlington, and the Corporation is in a dilemma. It wants to keep faith with Mr. Fraser, and at the same time realises that it is absolutely necessary to get a competent engineer. It offers a salary of £300 per annum to induce a good man to come forward, but at the same time makes it conditional that the engineer is a sub-servant to the borough engineer, who has not the necessary experience to be able to advise. He will be expected to do the work in connection with the electric light and traction station as well as the tramways installation, and when Mr. Fraser "comes home from the war," the duties will probably be divided; but a wary engineer will be wondering whether an attempt will be made to divide the salary as well.

Limerick. — At a meeting of the Limerick Harbour Board last week a letter was read from the Shannon Water and Electric Power Company, asking the Board's views in connection with the Bill which the company intends introducing in the next session of Parliament. On the previous occasion the Board approved of the scheme. It was decided by the Board to refer this fresh application to the Board's engineer for his advice.

Llandudno.—The D.C. has resolved to apply to the L.G.B. for leave to borrow £1,500 for extensions of the condensing plant at the electricity works.

London, E.C.—In reply to a question asked by Mr. A. C. Morton at the last meeting of the Court of Common Council, it was stated by Mr. Pryke, the chairman of the City Lands Committee, that the application of the City of London Electric Lighting Company for permission to increase the standard pressure of supply from 100 to 200 volts. They were able to withhold consent where the installation took place before June, 1898. It was stated that the change in pressure would result in an increased cost of 25 per cent. to consumers!

Notice is given by the City of London Electric Lighting Company, Limited, that as from the dates when the meter readings for the December quarter are taken, "and until further notice by public advertisement," the rates for electric energy supplied by the company for lighting purposes will be revised as follows:—For the current consumed during March and December quarters, up to and inclusive of the first six units per 8-C.P. lamp (or its equivalent), 8d. per unit will be charged, and for all current consumed in excess of six units per 8-C.P. lamp, 2d. per unit will be charged; while for the current consumed during June and September quarters up to and inclusive of the first three units per 8-C.P. lamp (or its equivalent), 8d. per unit will be charged, and for all current consumed in excess of three units per 8-C.P. lamp, 2d. per unit will be charged.

Long Eaton.—Mr. Crowther, the U.D. Council's electrical engineer, has submitted plans for the electric lighting scheme for the town, and it has been decided to apply to the L.G.B. for sanction to borrow £15,000 for carrying out the scheme.

Macclesfield.—At a special meeting of the T.C. held last week it was decided to apply to the B. of T. for a prov. order for the supply of electricity within the borough. The sum of £25,000 is mentioned as the amount to be spent on the works.

Manchester.—Mr. C. H. Wordingham, the city electrical engineer, in compliance with the instructions of the Electricity Committee, recently prepared a report "on the present state of the plans of Stuart Street generating station." One of the Manchester papers abstracts this as follows:—"The question was raised at the last meeting of the Sub-committee as to why the specifications were not in a more forward condition. When I entered into my agreement with the Corporation, four years ago, to act as their resident engineer at Dickenson Street and to advise them on all electrical matters, it was not for one moment contemplated by either party to the agreement what the magnitude of the electrical undertaking of the city was likely to become. At that time there was a talk of several of the outlying districts to the south of Manchester taking a supply of energy from the Corporation, but everything in connection with this matter was extremely doubtful and vague, and the supply of current in the southern part of the city was what was chiefly exercising the minds of the Committee. The actual development of events has been enormously greater than was anticipated. In place of being resident engineer for a station with 5,600 H.P. of plant, supplying about 1,500 consumers with some 143,000 lamps, I am now resident engineer for a station developing over 10,000 H.P. and supplying energy to 3,600 consumers, with 360,000 lamps. The whole of the management work for this station has fallen upon me." Mr. Wordingham goes on to say that the work that has devolved upon him includes the lighting of the whole of the city, supplying energy to an enormous outlying area, the responsibility of providing electrical equipment for the tramway system, this comprising the cars, overhead lines, and bonding of the rails, advising on a large fire alarm system, and the lighting of many public and semi-public institutions. He proceeds:—"I have never murmured at this nor raised any objection, because I held that I had undertaken by my agreement to continue to act as resident engineer and to advise the Corporation in connection with their electrical enterprise. I do not complain now. I could have carried out the work, and have brought everything to a successful issue, but during the last two years a great change has come over the policy of the Committee. They have multiplied sub-committees. They have required me to attend endless meetings of such sub-committees, not only in the electricity department, but in the tramways department. I have been called upon to present voluminous reports upon the most trivial matters—matters which have no concern whatever with the development of the undertaking, and which could have been disposed of without any report from me. These matters, which would have been amply sufficient for any one man to deal with, have consumed my time, and have absolutely precluded me from devoting my attention to the new work in hand. Notwithstanding this I have found time to design and to superintend everything in connection with the plant for an entirely new generating station of substantially greater capacity than the existing one, which has taken seven years to attain its present size. I have designed and superintended the laying of an immense system of high pressure mains, a system with which there is nothing comparable in this country. The whole of the work has been carried out by the Corporation's own staff, and only within the last 12 months have I had any assistance in the matter, and then only with the actual superintendence of the execution of the work. With all this work on my hands, I have been expected to personally interview ordinary labourers, and it has been no uncommon thing for me to have to expend half an hour or more explaining my reasons for discharging a workman who had made groundless representations respecting his discharge. It may be said, 'Why did I not depute my work to others?' In the first place, I felt that under my agreement the Corporation had the right to call upon me to do the work which they have required me to do, even though such a wide interpretation of my agreement was unreasonable. Secondly, it is impossible to depute the design of new work to another. The case is very different as regards management. The work might readily have been divided up into departments, each with a responsible head, but so long as I was held responsible for every detail of the management, and was not provided with a more adequate staff, the trouble and anxiety of deputing the work would have been greater than actually doing it. The committee have never shown a disposition to pay adequate salaries to secure efficient help, and unless this is provided, it is better to have no help at all. In conclusion, I say that the work as regards Stuart Street is as forward as it is possible for it to be in view of the enormous amount of work which I have had to do. The scheme is worked out, the general arrangement of the station is settled, many of the details are complete, and a considerable proportion of the specifications are prepared, and everything would have been ready in time had I not been hampered and fettered in the way which I have described."

Newbury.—The Board of Trade recently revoked the Electric Lighting Order granted to the borough. The Urban Electric Supply Company (Edmundson's Electricity Corporation, Limited) has submitted a draft of a prov. order with plan about to be deposited with the Board of Trade, and a committee of the Council is in negotiation with the company.

North Shields.—Owing to the way in which applications have come in, the Electricity Committee has decided to advertise for tenders for another generating set of 450 KW. This is very gratifying to the engineer and committee, seeing that the station is not yet ready. It is expected that the trial runs will shortly take place. Mr. Frank Forrest, of Messrs. Siemens Bros., has been appointed assistant electrical engineer.

Northampton.—The Northampton Electric Light and Power Company was summoned last week for causing smoke nuisance. For the defence it was stated that owing to the non-delivery of machinery which had been ordered over 12 months, great pressure had been put on two of the boilers, which in consequence emitted smoke, but mechanical stokers were now being employed. Further machinery (700 H.P.) would be fixed by the middle of January, and this would relieve the trouble. The magistrate adjourned the case for two months in order to see how things go with the new machinery in operation.

Peterborough.—On Wednesday last week the Corporation electricity works were formally inaugurated.

Pudsey.—The T.C. has decided to apply to the B. of T. for a prov. order for electric lighting.

Redditch.—The U.D.C. has found it necessary to levy a supplementary rate of 1s. in the £, principally to meet the deficiency on the electric lighting account. This is partly owing to the fact that the B. of T. insists on accounts being made up to December 31st, whereas the Council's financial year does not close till March 31st..

Ripon.—The City Council has decided to apply for sanction to a loan of £15,000 for electric lighting purposes.

Rockhampton (Queensland).—A deputation from this town has lately been to Brisbane in search of information relating to electric lighting and traction. Messrs. Trackson Bros., of Brisbane, have been instructed to report to the Rockhampton Council on a comprehensive street lighting and tramway service.

Pokesdown.—The U.D.C. has declined to give consent to the prov. order promoted by the Bournemouth and Poole Electricity Supply Company, and will, if necessary, oppose the grant of the same.

St. Austell.—The R.D.C. has given its consent to the application of St. Austell and District Electric Lighting and Power Company for a prov. order.

Siam.—The Siam Electricity Company recently resolved to acquire the Bangkok tramways on the best terms possible, also the Siam Electric Railways Company. The company has increased its capital to £170,000, with debenture powers for one-fifth that amount.

Southwold.—The T.C. is negotiating with the Coast Development Company, Limited, under the advice of Mr. F. J. Warden-Stevens, with a view to the electric lighting of the town.

Spain.—Application has been made to the Spanish Government for a concession to put down a plant to utilise the water-power of the River Gallego at Javierrelatre (Huesca province) in the generation of electrical energy for lighting and power purposes.

West Ham.—Mr. J. K. Bock, the borough electrical engineer, has reported to the Council on the subject of free wiring. The following is an abstract:—

"In order to cater for certain classes of consumers many schemes of free wiring (so called) have been tried. This work is, as a rule, carried out by companies who receive an agreed-upon price per unit for current sold in all installations fitted by them on this principle, the additional charge being levied on the consumers by the electricity works. This scheme has many disadvantages, the chief being, that it is an additional inducement to consumers to economise current and so to diminish the advantage of obtaining such consumers; it is unfair to the most profitable class of consumer (*i.e.*, the long-hour consumer) as he has to pay more per lamp for his wiring than a small current consumer; and it complicates the accounts by having two tariffs. About two years ago the Council, acting on the advice of Mr. Steinitz, obtained powers to borrow £10,000 for free wiring purposes, the suggested scheme being to the effect that a rental for each lamp installed should be charged, this rental being merely sufficient to cover the repayment of the loan and the interest on same. As the demand for electricity at the commencement of the supply proved sufficient to warrant the belief that the original plant would be fully loaded before new machinery could be erected, no further move was made in the matter. The following figures give an idea as to the power which will be available when the extensions are completed:—

	Equivalent in 8-c.p. lamps.
The power at present available	24,000
The lamps connected to mains	23,000
The maximum load at one time to date	17,000
The power which will be available with new plant	104,000

"The system of free wiring which I recommend you to adopt is what might be called a hire purchase system. As the period allowed for the repayment of the loan is shorter than was originally anticipated, the annual charge which it will be necessary to make, will be more than intending consumers would care to pay merely for the hire of the wiring and fittings. It will, therefore, be necessary to offer some additional inducement. This can be done by making the wiring and fittings the property of the consumer after the period for which the loan is granted has elapsed, or by permitting the consumer to pay for the installation in any number of years under this at a proportionate rate. In order to give an idea as to what this work could be done for, I asked two or three local firms to state a price at which they would be prepared to undertake the wiring of premises in the borough. The lowest price quoted was 13s. per lamp, and the highest 15s. I suggest that an agreement be entered into with as many contractors as are willing to undertake this work, by which the contractor would agree to wire any premises in the borough for a stated price; the wiring to be in accordance with certain rules and regulations issued by the Corporation; payment to be made by the Corporation on the installation passing the necessary test. I have estimated the additional number of 8-c.p. lamps which it will be necessary to connect to the mains in order to pay expenses at about 16,000.

"I submit to you the following proposals, being the method I suggest for carrying out this work:—

(*a*) That 18s. per lamp for shop and factory lighting and 15s. per lamp for private house lighting be paid by the Corporation to any contractor for premises wired by the contractor on this system.
(*b*) That an agreement be made with one or more firms of wiring contractors to wire any premises in the borough at the above prices.
(*c*) That payment be made immediately on the installation passing the necessary tests.
(*d*) That the consumer be charged 1s. 6½d. per lamp per annum for shop and factory lighting.
(*e*) That the consumer be charged 1s. 9½d. per lamp per annum for private house lighting.
(*f*) This sum is simply the amount necessary for the repayment of the capital and interest.
(*g*) That the administration charges be paid out of the electricity revenue.
(*h*) That a certain standard class of fittings be fixed.
(*i*) That 10 years be the maximum period allowed in which to pay for the installation.
(*j*) That, if desired, the purchaser may pay for the installation in any number of years he may choose, under 10 years.
(*k*) That lamps of good standard be supplied to all consumers at cost price.
(*l*) That arc lamps be hired on the same terms (*i.e.*, percentage of outlay and interest on same).
(*m*) That motors be hired at a charge of 6 per cent. on the outlay.

"In my preliminary report on this subject the question was raised as to the risk which would be run by the Corporation sinking money in premises over which no control could be exercised, and at the same time it was suggested that it would be advisable to obtain a deposit as security. The revenue from each 16-c.p. lamp averages about 10s. per annum after paying the working expenses. The amount which it would be necessary to charge for each 16-c.p. lamp per annum would be about 1s. 9d. Supposing 50 per cent. of the premises wired on this system were not in use, the other 50 per cent. would still be able to pay 8s. 3d. per lamp per annum towards the station expenses. From this it is evident that the risk of making a loss is very small indeed. I would also point out that any idea of making a consumer pay a deposit would be fatal to the success of the scheme, as it is perfectly obvious that if a consumer cares to deposit a sum equal to, or nearly equal to, the value of his installation, there can be no possible advantage to the said consumer in the hire purchase system."

ELECTRIC TRACTION NOTES.

Bolton.—The last completed section of the Corporation electric tramways to Deane and the Hulton district was first utilised on Friday night, when the members of the Tramway Committee with their general manager (Mr. H. England) and the borough electrical engineer (Mr. A. A. Day) took a trial trip over the new route, which is to be opened this week. The Brush Electrical Engineering Company are supplying a portion of the cars required by the Corporation; the first of these delivered is on the bogie principle, and has vestibuled ends. Its carrying capacity is 71 passengers. With a view to further extending the tramways, reconstructing the old lines and widening the streets of the town, the Corporation has resolved to seek borrowing powers by Parliamentary Bill for over half a million sterling.

City and South London Railway.—This company has deposited a Bill for powers to construct a subway from its authorised Islington extension to the Agricultural Hall, with which company agreements are sought to be sanctioned for the management of the proposed subway. The Bill also seeks an extension of time until August, 1902, within which to construct this extension, and in the meantime, power is sought to create £400,000 additional capital, of which £100,000 may be raised by the issue of debenture stock.

Dublin.—Before the Recorder on Wednesday last week, William McClure, a carter, brought an action against the Dublin United Tramway Company for damages sustained through the defendants not keeping their tramlines properly sanded, whereby his horse fell and he received serious injuries. The engineer to the company stated that he considered the line well kept, but the Recorder did not think, from the evidence, that this was the case, and awarded 8 guineas damages to the plaintiff.

Manchester—Liverpool.—The new Bill of the Manchester and Liverpool electric express, says the *Manchester Guardian*, will be very different from that promoted last session. Instead of the line in the Salford district being on the viaduct principle, the whole of the three miles will be laid in a cutting. This will be covered over at intervals in a similar way to that in which the London Underground was constructed, but instead of buildings being erected over the tunnels, it is proposed to leave open spaces there, so that the Corporation may make gardens, and thus create a beautiful promenade a mile long through the worst slum property of the town. The openings which it is proposed to leave as breathing spaces will have light bridges across at intervals—bridges 8 feet wide for foot passengers alone, and alongside them there will be walks connecting all the open spaces. This promenade, it is proposed, shall extend from near the site of the Manchester Racecourse to the Irwell. Near the Ship Canal Company's property, too, it is intended to erect workmen's dwellings to accommodate all the displaced slum dwellers. This scheme, it is hoped, will overcome the opposition of the Salford Corporation. The capital of the company is now fixed at £2,100,000.

York.—The City Council has passed a resolution to purchase from the City of York Tramways Company their undertaking, lines, &c., at £12,000; and cars, horses, &c., at a valuation.

Wimbledon.—The U.D.C. has decided not to proceed with its proposed Tramways Bill.

TELEGRAPH AND TELEPHONE NOTES.

Australian Telegraphs.—The Eastern Extension, Australasia and China Telegraph Company announces that in accordance with the agreement concluded in April last with the Governments of South Australia, West Australia and Tasmania, a further reduction of charges will take place on January 1st next, making the tariffs for the contracting colonies:—3s. 6d. per word for ordinary telegrams; 2s. 6d. per word for Government telegrams; and 1s. 4d. per word for Press telegrams. Should the "standard revenue" on which the reductions are based be still maintained, the tariff for ordinary telegrams will be further reduced to 3s. on January 1st, 1902, and to 2s. 6d. on January 1st, 1903, the tariffs for Government

and Press messages being also reduced. The tariffs for the non-contracting colonies remain unchanged.

Manchester Telephones.—The City Council once more discussed the question of the telephone service last week. It was resolved not to come to any decision until February, but in the meantime the Telephone Committee is to confer with the Salford and other urban authorities within the Manchester telephone area on the subject of telephony.

CONTRACTS OPEN AND CLOSED.

OPEN.

Asylum.—December 29th. The Committee of Visitors of the Winwick County Asylum, near Warrington, invites tenders for electric lighting, wiring, fittings, &c.

Battersea.—February 1st. Tenders are wanted for ordinary and prepayment electricity meters. Consulting engineers, Messrs. Kennedy & Jenkin.

Copenhagen.—January 3rd, 1901. The Corporation invites tenders for three 530-kw. dynamos, switchboards, &c. See "Official Notices" November 23rd.

Edinburgh.—December 31st. The Council wants tenders for the extension of the electric lighting installation at the City Chambers. See "Official Notices" December 21st.

Farnworth.—January 10th. The U.D.C. wants tenders for the supply of eight 66-passenger tramcar bodies, motors, under-trucks, controllers, &c. See "Official Notices" December 21st.

Glasgow. — January 18th. The Corporation wants tenders for the supply of telephone apparatus in connection with the Pinkston tramways power station. See "Official Notices" to-day.

Hendon.—December 31st. The U.D.C. wants tenders for Lancashire boilers, stokers, pumps and economiser; two 150-kw. steam dynamos, motor transformer, &c.; condensing plant, crane, switchboard work, battery, mains, meters, and workshop equipment for electricity works. See "Official Notices" November 16th.

Leeds.—December 31st. The E.L. Committee invites tenders for two 1,400-kw. two-phase steam alternators and two sets of surface condensing plant. "*British manufacture.*" See "Official Notices" December 7th.

Paraguay.—January 15th. The municipality of Asomption, Paraguay, is inviting tenders for the electric lighting of the town. Bond £600.

Partick. — January 7th. The Commissioners want tenders for steam dynamos, battery charging motor booster and balancer. See "Official Notices" December 14th.

Poplar.—January 16th. The Borough Council wants tenders for an electric crane (maximum load 5 tons). See "Official Notices" to-day.

Rathmines.—January 10th. The District Council wants tenders for Lancashire boiler, 300-kw. steam dynamo, condensing apparatus and pipework, switchboard extension, mains, and public lighting (incandescent). See "Official Notices" November 30th.

Rotherham.—January 19th. The Corporation wants tenders for the supply of a number of electricity meters. See "Official Notices."

Sheffield.—January 21st. The Tramways Committee wants tenders for a slow speed vertical engine for driving a 1,000-kw. tramway generator. See "Official Notices" December 21st.

Southampton.—January 7th. The Corporation wants tenders for the overhead electrical equipment of 1¾ miles of tramway route. See "Official Notices" to-day.

Sunderland.—February 1st. The Corporation wants tenders for condensing plant and cooling tower, secondary battery, mains switchboard, and travelling crane for the electric light station. See "Official Notices" to-day.

Stavanger.—January 2nd. Tenders are invited by the Stavanger Corporation for the establishment of electrical communication or transmission of power from the Altesrig Waterfalls to Stavanger, a distance of about 39 kilometres, in accordance with the plans of a civil engineer named Schoien. Tenders must be received by January 2nd, 1901. Further information may be obtained on application direct to Mr. E. Berentsen, British Vice-Consul, Stavanger.

Thetford.—January 1st. The Council wants tenders for wiring the new Town Hall.

Worthing.—December 31st. Tenders are wanted for a main switchboard. See "Official Notices" December 14th.

Worthing.—December 31st. The E.L. Committee invites offers from those firms willing to equip and maintain electric tramways. See "Official Notices" December 14th.

CLOSED.

Italy.—Tenders were recently opened by the Mediterranean Railway authorities in Milan, Italy, for the supply of 20 first and second class cars for the electric railway between Gallarate and Varese, as a result of which a contract has been placed with Messrs. Miani, Silvestre, Grondona, Comi & Co., of Milan, at 34,745 lires per car.

London.—The St. Pancras Borough Council received the following tenders for the supply of cables for extensions:—

British Insulated Wire Company	£2,868
Western Electric Company	2,820
Siemens Bros. & Co.	2,780
Callender's Cable Company (accepted)	2,597

The accepted tender is subject to a discount of 2½ per cent.

Southampton.—The Southampton Harbour Board at its last meeting dealt with a report from the Works Committee, announcing the receipt of a letter from the secretary of the Clayton Engineering Company, stating that the directors could not give any personal security in regard to contracts of the company, nor did they consider that they should be required to do so, and the signing of the contract was left over pending the receipt of a reply. The committee resolved that a reply be sent that the contract and bond forwarded for signature was in accordance with the tender sent in by the company, and that unless the contract was received by the Board duly executed not later than the 17th inst., the acceptance of the tender would be withdrawn and cancelled. A letter had been sent to Messrs. Stothert & Pitt, Limited, of Bath, inquiring if their tender for the construction of the electric travelling crane was still open for acceptance. Alderman Bone, in moving the adoption of the report, said that as the Clayton Company would not conform with the terms of the advertisement it was for the Board to consider whether they would forego personal security and accept the 40 per cent. payment as offered, instead of 80 per cent., or accept the committee's recommendations. The Clayton Company's tender was £735, and the next lowest was £798, but the committee recommended that the tender be placed with Messrs. Stothert and Pitt, though their price was £950, because they would give personal security. They had supplied nearly all the cranes on the Town Quay, and had given every satisfaction. The report was adopted.

Woolwich and Plumstead Council.—The Woolwich new Borough Council has agreed on the whole to carry out the proposals of the Plumstead Vestry, with regard to electric lighting, but subject to sundry exceptions of the application of the late vestry's byelaws with regard to sub-letting and wages clauses. The Committee recommend the acceptance of the following tenders:—

Refuse destructor.—Meldrum Bros., Limited, furnaces, £7,885 5s.; Babcock and Wilcox, Limited, three water-tube boilers at £697 15s. each, and furnace fittings, £2,138 5s.

Electricity Works.—Babcock & Wilcox, Limited, water-tube boiler 300 I.H.P. and fittings, £862 15s.; boiler fittings and mountings, Babcock & Wilcox, Limited, £580 9s. 4s.; economiser, Babcock & Wilcox, Limited, £595; steam exhaust and other piping, auxiliary tanks, steam traps, and oil separators, Aiton and Co., £3,109; heater detartariser and well pumps, W. Boby, £1,356; Worthington Pumping Engine Company (four feed pumps), £440; dynamos, &c., British Westinghouse Electric Company, Westinghouse-Willans steam dynamos (two of 300 I.H.P., two of 150 I.H.P., one of 109 I.H.P.), booster and other works in connection therewith, £8,800 10s.; condensing plant and cooling tower, Wheeler Condenser Company (subject to report of electrical engineer), £2,613; switchboard, connections, &c., J. White, £1,237 3s. 10d.; storage batteries, Eclipse Brass and Copper Company, Limited, York, £863 5s.; travelling crane, Carrick & Ritchie, Edinburgh, £640; underground mains, Callender's Cable and Construction Company, Limited, £13,078 9s. 2d.; demand indicators, &c., British Electric Meter Company, Limited (100 sets), £579 17s.; meters, Schattner Electricity Meter Company, Limited, Norwich (100 electrolytic meters), £298 12s. 6d.; extra on 30 of such 100 with slot arrangement for prepayment, £18 15s.; arc lamps and posts, Johnson & Phillips, £2,100.

FORTHCOMING EVENTS.

Thursday, January 3rd.—At 8 p.m. Civil and Mechanical Engineers' Society. "The Case for Electric Power Distribution," by W. B. Esson, M.I.E.E.

At 8 p.m.—The Röntgen Society, at 20, Hanover Square. Paper by Mr. A. W. Isenthal on "Continental Progress in Practical Radiography and Apparatus." Dr. J. H. Sequiera will show some cases of Rodent Ulcer treated with X rays.

Future Arrangements.—Paper upon "X Ray Work during the late Military Operations," by Lieut. F. B. Bruce, R.A.M.C. —Discussion evening: Subject, "X Ray Therapeutics," opened by Miss M. Sharpe, L.R.C.P.—Paper by Mr. J. Cadett on "Some X Ray Improvements."—An exhibition evening.

Wednesday, January 9th.—At 8 p.m. Institution of Electrical Engineers (Glasgow Section). Meeting at the Institution of Engineers and Shipbuilders, 207, Bath Street.

Thursday, January 10th.—At 8 p.m. Institution of Electrical Engineers. Meeting at Society of Arts.

NOTES.

A Happy New Year to All.—This being the last issue of the Electrical Review to appear during the year 1900, we take this opportunity of wishing our numerous readers and other friends connected with the electrical profession and industry a happy and prosperous new year. The last few years have been periods of great progress; may the new century open with a still more satisfactory year.

Electric Canal Haulage.—*A propos* of this subject, which is referred to in our leading columns, it is rumoured that an influential syndicate of American capitalists has lately been examining the Continental inland waterways, with a view to the wholesale introduction of electric motive power, and that the British canal system is included within the field of its proposed operations. If it really attempts to carry out this project, the syndicate will meet with difficulties sufficient to appal the boldest spirits; the various power companies to which Parliamentary powers have recently been granted will in themselves constitute obstacles of the first magnitude, unless the electric power is obtained from them. Our object in mentioning the rumour, however, is to draw attention to the fact that already foreign capitalists have their eyes upon the tempting possibilities of electric haulage on our canals, and that the time is ripe for this matter to be taken in hand. The very fact that a supply of electricity in bulk will shortly be available over large areas ought to be of great assistance to the carrying out of projects of this nature, while the character of the traffic is such as would render the adoption of electric power a far more simple matter than in the case of main lines of railway.

Lectures.—Before the Midland Institute Scientific Society at Birmingham on 19th inst., Mr. T. H. Waller lectured on "Electrolysis."

Prof. S. P. Thompson delivered a lecture on "Electricity at Work" to over 3,000 children and a few hundred adults at St. George's Hall, Bradford, on 21st. inst. The lecture was given under the auspices of the Bradford Philosophical Society. The reverend chairman said that the young people present were "truly representative" of the future citizens of Bradford. At several later stages he reproved them for their trifling and inattention; for this, however, they atoned somewhat, by giving three hearty ringing cheers for the lecturer. Prof. Thompson showed a large number of entertaining experiments, and concluded by driving home the importance of electrical power distribution from large stations situated at the pit's mouth.

At the Insurance Institute of Newcastle-upon-Tyne on 12th inst., a paper was read by Mr. Lester Taylor, entitled "Practical Hints on Electrical Installation."

The Nernst Light Company's Meeting.—In the report of this company's meeting, which was given in our last issue, reference to a certain statement made by Mr. Bernard Drake in the course of his speech was omitted. The remarks were as follows:—"Our thanks, however, are due to the Allgemeine Elektricitäts Gesellschaft, of Berlin, for having used their large resources to prove that the Nernst lamp is a practical success, which has obtained a Grand Prix in Paris, and we shall test with interest the 300 lamps which are now on their way to our laboratory."

Obituary.—It is with feelings of genuine regret that we record the death of Lord Armstrong, who passed away at Cragside, early yesterday morning, at the advanced age of 91 years.

Appointments Vacant.—A municipal electrical engineer is required for the Foreign Community of Shanghai at £510 per annum. The West Ham Union wants an expert to advise regarding certain engineering and electrical work. A principal is required for the Sir John Cass's Technical Institute, Jewry Street, Aldgate, at £500 per annum. A borough electrical engineer at £200 per annum is wanted for Rotherham. The London County Council is now inviting applications for the position of electrical engineer for electric tramways construction at £1,000 per annum. See "Official Notices" to-day.

'Appy 'Ampstead and the 'Eath.—The Hampstead Heath Protection Society will offer deadly opposition to a certain underground electric railway. One reason given is that a tunnel beneath may injure the heath!

Wireless Telegraphy in Germany.—The *Times* correspondent at Berlin states that on Saturday last Prof. Slaby, of the Charlottenburg Technical High School, gave an interesting lecture before the Emperor and a distinguished company upon improvements which he and his former assistant, Count Arco, have made in the art of wireless telegraphy. It has not hitherto been possible to use wireless telegraphy for communicating with several different stations at the same time. Prof. Slaby has now succeeded in overcoming this difficulty, and on Saturday night he conversed from the conference room of the Allgemeine Electricitäts-Gesellschaft in Berlin with operators in the laboratory of the Technical High School at Charlottenburg and in the works of the Allgemeine Electricitäts-Gesellschaft at Ober Schönweide. These two stations are distant about two and eight miles respectively from the conference room in which the experiment was conducted. The conversations were carried on in the Morse code. Prof. Slaby used two instruments, both of which were connected with a lightning conductor in the neighbourhood and were not insulated from the earth. One of the instruments was made to correspond exactly with that in the laboratory at Charlottenburg, the other with the instrument in the works at Ober Schönweide. The experiment was a great success, especially in view of the fact that the greater part of Berlin separated the conference room from one of the stations with which the conversation was conducted, and that the numerous chimneys interfered with the transmission of the electrical waves. This difficulty was overcome by means of a coil of wire which the waves passed through on their way from the lightning conductor to the receiving instruments, and which, by shortening the waves, increased their intensity. The Emperor displayed the greatest interest in the experiments, which were explained by the professor in his lecture. His Majesty afterwards conversed for some time with Prof. Slaby and Count Arco, as well as with the Imperial Secretary for the Navy, Admiral von Tirpitz, and the director of the Allgemeine Electricitäts-Gesellschaft, Herr Rathenau.

Aluminium.—Aluminium is, at the present price, the cheapest metal in the market, with the exception of iron, zinc, and lead. This metal is now extensively used in place of copper, brass, tin, and in some cases even iron, especially when the reduction of dead weight is a question of great importance. Aluminium is also beginning to be very largely used in connection with electricity, as electrical conductors on this metal, giving the same conductance as copper, weigh only half as much, and cost less. It is impossible to foresee the ultimate extent of the use to which this metal can be put, but the progress made in aluminium during late years justifies the most sanguine expectations. Twenty years ago, the total output in the world did not exceed 4 or 5 tons, and its price was about £6,000 per ton; 10 years ago its price was reduced to about £2,000 per ton, and the output increased to about 30 tons per annum; now the price is from about £130 to £140 per ton, and the output during the last 12 months is reckoned at 5,000 tons. Considering the number of uses to which this metal can be put, the output is yet very insignificant in comparison with the output of other metals. Up to the year 1854 aluminium was nothing but a laboratory curiosity, but after that date small works for its production on a commercial scale were put up, both in England and France. It is only during the last 10 years, since the production of aluminium by the electric process has been started, that it has been possible to put it in the market at such a price as to compete with other common metals, with the result that in 10 years the demand has increased from 30 to 5,000 tons, and will undoubtedly go on increasing at a very rapid rate. Aluminium is only produced in the world by four different companies, viz., the British Aluminium Company, who are the sole producers for the United Kingdom and the Colonies; the Pittsburg Reduction Company, the sole producers for the United States; the Société Electro-Métallurgique Française, the sole producers for France; and the Société Anonyme pour l'Industrie de l'Aluminium, the sole producers for the rest of the Continent.

German Competition in Australia. — The recent decision of the Melbourne City Council to place an electrical contract with a German firm has drawn the following protest from the Trades' Hall Council :—"That this Council enters its protest against the action of the City Council in ignoring the settled policy of the country."

SUPPLY STATION ACCOUNTS.

Cork Electric Tramways and Lighting Company.

The accounts of the Cork Company, which operates the local electric tramways, and also gives a general supply of electrical energy, are made up in two forms. One of these covers the costs supposed to be entailed by the lighting supply, and complies with the clauses of the transfer of the lighting order from the Corporation. The other shows the detailed figures, treating the business as a system for supply to both the tramways and lighting. We have summarised both of these, but the detailed figures deal with the whole supply.

Supply was started in August, 1898, and the trams commenced running in December of that year. The accounts for 1899, therefore, cover the first complete year of working. A separate station has been laid down at Queenstown, which only commenced running this year. A sum of £4,656 appears in the capital expenditure on account of this station. Permanent way, cars, &c., in the capital account absorb £105,909.

GENERAL STATEMENT.

	189—	1899.	Increase.
Total capital expenditure ...	—	£235,674	—
Number of units sold	—	1,152,429	—
Number of lamps connected ...	—	29,664	—
Maximum load in KW.	—	826	—
Gross revenue	—	£26,873	—
Gross expenditure...	—	£15,367	—
Gross profit	—	£11,506	—
Average price per unit sold* ...	—	2·50d.	—

* Private supply only.

The sales of energy to the two principal sources of revenue were :—Traction 579,933 units, and private consumers 572,496 units, but a further 26,088 units were consumed in the public lamps, although these were not taken over by the Corporation, and the company did not obtain any revenue from them until this year. It would be perfectly justifiable to treat these as units sold in the costs, but to avoid confusion, we have retained the figure given in the general statement. Of course, the costs would be rather better if the units actually used in public lamps were included as sales. The rates of charge in 1899 were for lighting, 5d. for first two hours and 1d. afterwards on the demand system. No extra charge is made for maintenance of motors, but lamp renewals are not "free," save in the practical sense that it is assumed that ½d. out of the 5d. charge for the first two hours is a rate to cover this work. Motive power was charged during 1899 at 4¼d. and 1d. on the demand principle.

REVENUE STATEMENT.

	189. Gross.	189. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy *	—	—	£5,973	2·50d.	—
Meter rents *	—	—	278	·12d.	—
Supply of lamps, &c.*	—	—	442	·19d.	—
Sundry fees, &c.*	—	—	76	·03d.	—
Tramway traffic revenue † ..	—	—	20,104	8·32d	—
Gross revenue ‡ ...	—	—	£26,873	5·60d.	—

* From lighting only, *i.e.*, 572,496 units. Total from lighting = 2·84d. per unit.
† From traction only, *i.e.*, 579,933 units.
‡ From total units, *i.e.*, 1,152,429 units, averaging over all sales.

The costs of production are set out as nearly as possible in the form in which the items appear in the published accounts. Eliminating the traction costs outside the station, we get 1·61d. as the total per unit. Borrowing the figures estimated, and put down for lighting only, and allowing in the sales the units taken by the public lamps, the results stand somewhat as follows :—

Lighting only.	Private sales	572,496
	Public lamps	26,088
	Total	598,584 units.
Works cost		£3,323 or 1·33d. per unit.
Total cost		4,847 or 1·94d. „

COST OF PRODUCTION.

	189. Gross.	189. Per unit.	1899. Gross.	1899. Per unit	Increase.
Coal	—	—	£2,280	·48d.	—
Oil, waste, water and engine room stores.	—	—	311	·06d.	—
Salaries and wages incurred in generation and in distribution.	—	—	1,574	·33d.	—
Repairs and maintenance of buildings, engines, boilers dynamos, &c.	—	—	977	·20d.	—
Works costs	—	—	£5,142	1·07d.	—
Rent, rates and taxes ..	—	—	263	·06d.	—
Management expenses, salaries of managing engineer, secretary, clerks, &c.	—	—	1,173	·24d.	—
General establishment charges, stationery and printing, law charges and insurance	—	—	615	·13d.	—
Renewal of lamps and attendance on motors	—	—	527	·11d.	—
Traction costs..	—	—	7,647	1·59d.	—
Total costs ...	—	—	£15,367	3·20d.	—

Of course, in the case of a company like this, with traction, public lighting, and private supply, the figures might be shown to mean very different things, depending upon their allocation, and we must congratulate Mr. C. H. Merz, the responsible engineer, upon the clear manner in which the whole of the data is presented, as well as upon the large output and successful results attained in the first complete year of operation. We do not attempt to draw any comparisons; indeed, such would most likely be misleading unless another station could be found with a similar load and with accounts drawn up in the same manner.

PROFIT STATEMENT.

	189.	1899.
Interest on debentures and loans	—	£3,265
Writing off preliminary expenses	—	158
Dividend paid on stocks and shares	—	8,083
Gross profit	—	£11,506

CITY NOTES.

Douglas Southern Electric Tramways Company.

The fifth annual meeting of this company was held on 18th inst. in Manchester, Mr. T. J. Hutchinson presiding. The report of the directors, which showed a profit on the year's working of £1,617 14s. 9d., was moved and adopted. The CHAIRMAN in his speech said that taking everything into consideration, they had had a very fair season, notwithstanding that the Isle of Man season had not been up to the usual standard. Their receipts had increased slightly, and he thought their line was becoming more popular. An awful calamity had befallen the island since the last meeting, but he hoped the island had now been cleared of some of the rottenest finance that had taken place in the history of company promoting, and that it would survive its difficulties. He believed that what had transpired would be for the benefit of all concerned. As regards their own company, efforts were being made to bring their line into more immediate touch with Douglas town, and they were hoping to make such arrangements with the Douglas Corporation as would be for the good of the people of Douglas. Their lines and plant were kept in perfect repair out of the revenue, therefore the directors had not thought it necessary to set aside any depreciation. They regretted there was no dividend for the ordinary shareholders, but he might remark that 6 per cent. was being paid to the preference shareholders, and if that were divided equally between the whole of the shareholders it would amount to nearly 4 per cent. all round. The company was solvent, and the shares were likely to improve in value.

London Electric Omnibus Company.

In accordance with the desire expressed by the shareholders at the last general meeting, that the business of the company should be continued, and that the directors should endeavour to formulate some scheme with a view of placing the business on a sound financial basis, the board have gone carefully into the matter, and have laid their conclusions before the shareholders in a circular accompanying the report. The *Times* states that the directors are of opinion that electricity as applied to street traction (except as regards tramways) has not been developed sufficiently to warrant their advising the shareholders to experiment further with it. They call attention to the fact that the automobile car has become an accomplished fact. There is, in the opinion of the directors, ample scope for a business capable of meeting the requirements of the overloaded traffic in London, and they consider that a service of at least 300 street cars could be effectively utilised for the benefit of the public. They state that they have reason to believe that a type of street car to carry 14 passengers can be procured, which would, in their opinion, be most suitable for London streets, at an inclusive

price of not more than £450, 20 of such street cars being considered a sufficient number with which to start business. The order for these cars would be conditional upon the makers' guarantee and a running test of one or two of the cars for at least 30 full working days consecutively being satisfactory. If a sufficient number of the shareholders assent within 10 days to a scheme described in the circular, the directors propose that the company be wound up voluntarily with a view to reconstruction, and that a new company be formed to acquire and work the undertaking of the present company.

Prospectus.—The Bastian Meter Company, Limited, is inviting applications for 2,834 £1 ordinary, and 1,222 £1 preference shares for working capital. The nominal capital is £50,000, of which £39,944 is already issued. The list is to close on Monday next, 31st inst. The company was formed in 1897, and the manufacturing profits have been employed in the development of the business which is undoubtedly progressive, and in view of the increasing extension of electric lighting, should have a good future before it.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in—Kalgoorlie Electric Power and Lighting Corporation, Limited—150,000 6 per cent. cumulative preferred shares of £1 each, 10s. paid, Nos. 1 to 150,000. Marconi's Wireless Telegraph Company, Limited—77,083 shares of £1 each, fully paid, Nos. 1 to 40,000, and 100,001 to 137,083; and 60,000 vendors' shares of £1 each, fully paid, Nos. 40,001 to 100,000. Motor Manufacturing Company, Limited—246,432 shares of £1 each, fully paid, Nos. 1 to 246,432.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending December 22nd were £164; corresponding period last year, £124; increase, £42. Total to date, £20,164; corresponding period last year, £20,083; increase, £81.

Bristol Tramways and Carriage Company.—The receipts for the week ending December 22st were £3,801 18s. 0d.; corresponding period last year, £2,763 12s. 3d.; increase, £1,038 5s. 9d.

Central London Railway.—The receipts for the week ending December 22nd were £6,135; previous week, £6,006; increase, £129. Total receipts to date (21 weeks), £111,568. Miles open, 6.

City and South London Railway.—The receipts for the week ending December 23rd were £1,920; corresponding week last year, £1,194; increase, £726. Total to date, £41,569; corresponding period last year, £25,016; increase, £16,553. Miles open, 1900, 4½; 1899, 3½.

Cork Electric Tramways and Lighting Company.—The receipts for the week ending December 20th were £379 19s. 8d.; corresponding week last year, £332 7s. 9d.; increase, £47 11s. 11d. Total to date, £20,748 0s. 8d.; corresponding period last year, £19,310 7s. 0d.; increase, £1,537 13s. 8d.

Dover Corporation Tramways.—The receipts for the week ending December 22nd were £182 8s. 11d.; corresponding week last year, £151 7s. 11d.; increase, £31 1s. 0d. Total to date, £10,483 8s. 0½d.; corresponding period last year, £9,886 5s. 8d.; increase, £547 2s. 4½d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,967; 1899, 4,778. Number of cars, 1900, 11; 1899, 11.

Dublin United Tramways Company.—The receipts for the week ending December 21st were as follows:—D. U. T. Co., electric cars, £3,547 1s. 10d.; ditto, horse cars, £22 15s. 0d.; D. S. D. Co., electric cars, £762 15s. 5d.; total, £4,332 12s. 3d; corresponding week last year—D. U. T. Co., electric cars £3,107 11s. 11d.; ditto, horse cars, £120 15s. 10d.; D. S. D. Co., electric cars, £647 9s. 0d.; total, £3,875 16s. 9d.; increase, £456 15s. 6d.; aggregate to date, £115,561 3s. 0d.; aggregate to date last year, £108,133 15s. 6d.; increase, £12,427 7s. 6d. The mileage worked is 44 miles electrically, 1 mile by horses, as against 37 miles electrically, 7 miles by horses, for the corresponding period last year.

STOCKS AND SHARES.

A Brief Review of the Year.

There is no escaping from the fact that war is a distinctly bad thing for investors. Here and there a few particular industries flourish on the results of the evil, but to the body of monied classes as a whole its effects are only bad. To emphasise our point, it is but necessary to glance at the investment markets of the Stock Exchange and note the current of prices during the present twelve-months, now so rapidly dwindling. Even such a steady and improving department as that devoted to electric supply shares, presents an unhappy record when to-day's prices are compared with those that ruled at the closing business day of last year. We may cite a few representative examples:—

Company.	Dec. 30, 1899.	Dec. 24, 1900.	Fall.
Brush Ordinary	1⅞	1⅝	⅛
Charing Cross	10	10	—
Chelsea	8	6¾	1¼
City of London	10½	9¼	1
Edmundson's	5	4¾	¼
Metropolitan	13½	12⅝	1
Notting Hill	16	15	1
St. James's	15¼	15¼	—
Westminster	14	13	1

There is no single rise to break the motonony of the weakness. Dear money, dear wages, dear material—these are the skeletons that have haunted the market's cupboard through the past twelve months, and all are more or less directly traceable to the South African hostilities. The supply companies have been doing capital business in most cases, but their expenses have been abnormally high. Notwithstanding this, several managed to increase their dividends at the last distribution. One feature of the year worthy of special mention is the large amount of new capital issued by the supply undertakings, and nearly all the money was readily subscribed by the public.

Turning to telegraph companies, we again find a fall marked on the year in the majority of instances. We give a few:—

Company.	Dec. 30, 1899.	Dec. 27, 1900.	Fall.
Anglo (Pref.)	115	98	17
„ (Def.)	17	10⅜	6⅝
Cuba Submarine	9	7	2
Direct Spanish	4½	4	½
Eastern	145½	138½	7
Eastern Extension	14½	14	½
Great Northern	32	33	—
Reuter's	7½	7½	—
West India and Panama	1	¾	¼

In this section, the "rig" which worked up the price of copper to a ridiculous height is in some degree responsible for the decline shown. But each undertaking has its own particular burden to bear. The Anglo-American companies have now to face a German competitive line opened last autumn. The Eastern stocks are wavering under the fear of how the companies may be affected by the laying of the new Pacific cable. West Indian concerns have suffered in the comparison of their receipts this year, as against those for 1898, when business boomed after the Hispano-American war. Dividends have been well maintained in the Eastern group, reduced in regard to the West Indian division, and now it seems pretty certain that the distribution on the American lines must also be lowered, although the recent boom in "Yankees" must prove a veritable godsend to them.

In common with all railway stocks and shares, those of the little electric railway department have had a bad time of it in 1900—not so bad, though, as they would have experienced had not the "Twopenny Tube," opening last July, sprung at once into popular favour. Within the last few weeks rumours of litigation and reports about the rolling stock have combined to depress the price of Central Londons, while City stock, after remaining manfully in the neighbourhood of 60 for several months, gave way at the offer of new £10 shares at 5½. We append the list of changes for the year:—

Company.	Dec. 30, 1899.	Dec. 27, 1900.	Fall.
Central London	9⅜	9⅛	¼
City and South London	60½	54	6½
Waterloo and City	101½	95½	6
British Electric Traction	15½	14	1½

Notwithstanding the way in which electric traction has been developing British Electrics are easier. The tramway market has undergone an uneventful period, almost the only sensation being a smart rise in Dublin trams upon the occasion of Her Majesty's visit to Ireland in the summer.

We conclude our short summary with a list of well-known manufacturing companies' shares, and here the results are considerably more cheerful:—

Company.	Dec. 30, 1899.	Dec. 27, 1900.	Rise.
B. Insulated Wire	12	11¾	(Fall) ¼
Callender's	18	18	—
Electric Construction	2⅛	2⅛	—
Henley's	12¾	13	¼
India-Rubber	21	21½	½
Tel. Construction	36	40	4
Tel. Manufacturing	9½	10½	1

The great activity that has prevailed all over the world in connection with manufacture of telegraph and kindred specialities shows to a marked extent in the improved position as regards the finances of the more important companies. With the prospect of cheaper coal and other items in the near future, they should do still better in the coming century. National Telephones started 1900 at 4⅞, and finish it up at 4½; those who have to endure the present state of the London streets are miserably cognisant of the reason for the fall.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotations Dec. 19th.	Closing Quotation Dec. 24th.	Business done during week ended Dec. 24th, 1900. Highest.	Lowest.
96,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
119,700	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	85 — 90	85 — 90	...	...
822,700	Anglo-American Telegraph	Stock	3 %	£3 9s.	73/6	52 — 55	52 — 55	52	...
3,088,540	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	97 — 99	97 — 99	98½	97
3,088,540	Do. do. Deferred	Stock	...	18s. %	£1 7s.	10 — 10½	10 — 10½	10⅜	10⅛
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	3 %	4 %	3 — 3½	3 — 3½	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	170 —180	170 —180	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104	102 —104	103½	103
16,000	Cuba Telegraph	10	7 %	8 %	7 %	6½— 7½	6½— 7½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	15 — 16	15 — 16	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3½— 4½	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	100 —104 %	100 —104%	...	...
60,710£	Direct United States Cable	20	3¼%	3½%	3 %	10 — 10½	10 — 10½	...	...
108,300	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	136 —141	136 —141	138	136½
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	96 — 99	96 — 99	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	110 —114	110 —114	112½	111½
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13⅞— 14½	13⅞— 14½	14⅛	13⅞
50,000	Do. Nos. 250,001 to 300,000 (iss. at £3 pm. all pd.) £6 pd.	10	...	...	...	9¼— 9⅝	9¼— 9⅝	9⅛	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	113 —118	113 —118	115	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	102½	..
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	99 —102%	99 —102%	102	...
180,227	Globe Telegraph and Trust	10	4½%	5⅛%	5¼%	10¼— 10⅝	10¼— 10⅝	10⅛	...
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15 — 15½	15 — 15½	15⅜	...
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	12½%	...	31 — 33	31 — 33	...	...
82,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	104 —107	104 —107	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	...	2½%	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	4 %	5 %	¾— 1	¾— 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	6 %	5 %	4⅜— 4⅝	4⅜— 4⅝	4 5/16	4¼
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	11 — 13	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	5 — 5½	5 — 5½	5	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 99	96 — 99	96½	...
500,000	Do. 4 % Deb. Stock Red.	100	...	...	...	101 —104	101 —104	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1⅛	⅞— 1⅛	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	101 —104	101 —104	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	123 —128	123 —128	...	...
58,000	United River Plate Telephone	5	5 %	6 %	7 %	4½— 5	4½— 5	...	...
16,639	Do. do. 5 % Cum. pref. Nos. 1—16,639	5	...	...	...	5 — 5½	5 — 5½	...	...
23,361	Do. do. Nos. 16,640 to 40,000 £3½ pd.	5	...	...	...	3½— 3¾	3½— 3¾	...	...
179,947	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	7 %	14 — 14½	14 — 14½	14¼	...
75,000	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	103 —106	103 —106	...	...
348,777	Do. do. 4 % Deb. Stock Red.	100	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	¾%	2 %	⅝%	⅝— ⅞	⅝— ⅞	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	6 — 7	6 — 7	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	5 — 7	5 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	105 —108	105 —108	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref....	5	7 %	...	...	8½— 9½	8½— 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9½— 10½	9½— 10½	...	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	6 %	6½— 7	6½— 7	6⅞	...
150,000	Do. do. do. % Deb. Stock Red. ...	Stock	4½%	...	...	110 —113	111 —114	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	10 %	6 %	4 %	9 — 10	9 — 10	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	13 — 14	13 — 14	13½	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	4 %	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11½— 12½	11½— 12½	12 1/16	12
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	108 —111	108 —111	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5	4½— 5	4⅞	4¾
75,000	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	102 —105	103 —106	105	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 2	1½— 2	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	6 %	...	4½— 5	4 — 5	...	...
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	98 —101 xd	98 —101 xd	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	12 — 13	12 — 13	...	...
220,000£	Do. 4½% First Mortgage Debenture Stock	...	4½%	...	...	112 —115	112 —115	...	...
250,000	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	98 —101	98 —101	...	...
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	14½— 15½	14½— 15½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
150,000	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	100 —103	100 —103	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000	Do. do. 4 % Deb.	100	...	...	...	85 — 95	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2½— 3½	...	...
70,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	12 %	13 %	12 — 13	12 — 13	13	...

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of
Quotations on Liverpool Stock Exchange.
‡ Dividends paid in deferred share warrants, profits being used as capital, the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation Dec. 19th.	Closing Quotation Dec. 24th.	Business done week ended Dec. 24th, 1900. Highest	Lowest
		†							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	8½ — 9½	8½ — 9½	...	...
300,000	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	91 — 95	91 — 95	...	...
45,000	British Electric Traction	10	...	6 %	...	13½ — 14½xd	13½ — 14½	13½	...
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	...	...
350,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	120 —123	120 —123	122	...
85,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	⅛ — ¼	⅛ — ¼	...	...
50,000	† Do do. 6 % Cum.Pref., 1—50,000 ...	...	...	...	...	⅛ — ¼	⅛ — ¼	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	97 — 99	97 — 99	...	...
70,000	British Insulated Wire Ord.	5	15 %	15 %	20 %	11 — 12	11 — 12	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅝ — 6¼	5⅝ — 6¼	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	3 %	5 %	6 %	1⅝ — 1⅞	1⅝ — 1⅞	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	6 %	2 — 2¼	2 — 2¼	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	106 —111	106 —111	...	...
108,710	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	103 —105	103 —105	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	12½%	15 %	15 %	12½ — 13½	12½ — 13½	...	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5¼ — 5¾	5¼ — 5¾	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	111 —115	111 —115	...	...
206,297	Central London Railway, Ord. Shares	10	...	...	...	9½ — 9⅝	9½ — 9⅝	9⅝	9½
78,703	Do. do. Pref. half-shares	5	...	...	...	4⅝ — 5¼	4⅝ — 5¼	5¼	5⅛
78,703	Do. do. Def. do.	5	...	...	...	4 — 4½	4 — 4½	4⅜	...
855,000	City and South London Railway	Stock	1⅞%	2⅛%	1⅞%	52 — 56	52 — 56	...	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	4½ — 5½	4½ — 5½	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	...	6 %	7½%	3½ — 4	3½ — 4	...	...
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	6 %	1⅜ — 2¼	1⅜ — 2¼	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	6 %	3½ — 4⅛	3½ — 4⅛	...	...
344,023	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	90 — 92	90 — 92	...	...
100,000	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	96 —100	96 —100	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	2 — 2¼	2 — 2¼	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	7 %	...	2⅜ — 3¼	2⅜ — 3¼	...	...
182,500	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600	10	7 %	7 %	7 %	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	12½ — 13½	12½ — 13½	13⅛	12¾
30,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5¼ — 5⅝	5¼ — 5⅝	5⅝	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	...	...	108 —112	108 —112	11¼	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅜	...
300,000	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103	101 —104	102½	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¼%	3¼%	3⅜%	8⅜ — 8⅞	8⅜ — 8⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5	13½ — 13⅝	13½ — 13⅝	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	38 — 42	40	39½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...%	101 —104	101 —104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	8 %	12 %	10 — 11	10 — 11	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5¼ — 5⅜	5¼ — 5⅜	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	94 — 97	94 — 97	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Brompton and Kensington, 4½ % Debentures of £100, 103—106.
Consolidated Telephone Construction and Maintenance, 3/—5/-
National Electric Free Wiring, 12/6 paid, ¼—⅜.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 16—17.
Do. do. Pref. (£10 pd.), 10—10½.
* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 11½—12½; 1st Preference Cumulative 6 % £5 (fully paid), 6¾—7¼. Debentures, 102—105. Dividend, 1899, on Ordinary Shares 11 %.
*T. Parker, £10 (fully paid), 16½.

Bank rate of discount 4 per cent. (July 19th, 1900)

INSTITUTION OF ELECTRICAL ENGINEERS.

ON RAPID VARIATIONS IN THE CURRENT THROUGH THE DIRECT-CURRENT ARC.

By W. Duddell, Wh. Sc., Associate.

(*Paper read December 13th*, 1900.)

(*Continued from page* 1002.)

Sounds Emitted by Very Short Arcs.—A very short hissing arc, so short that practically no light can get out from between the carbons, sometimes produces a shrill whistling sound, accompanied by a small tongue of green flame. The variation of P.D. and current for such an arc are given in fig. 8, in which the current and P.D. have varied between two limits, viz., 22·5 amperes at 24 volts and 28 amperes at 9·5 volts, the former of which would produce a hissing arc, while the latter values of the current and P.D. can only be explained on the assumption that the arc is short circuited by a bad contact, such as a loose piece of carbon. The whistling sound is probably due to the periodical short circuiting and relighting of the arc.

Sounds Emitted by Very Long Arcs.—The frying sounds emitted by very long arcs, noticed by Mrs. Ayrton,* are probably due to the fact that long arcs are very sensitive as telephone receivers, as mentioned in Part I., so that very slight variations in the current will cause them to give out sounds. In confirmation of this it may be mentioned that a *very long silent* arc can be obtained if the arc is supplied with current from *accumulators* which are *not* in use for *any other* purpose, and if the arc circuit be so arranged that *no* variations of the current can be induced or produced in it by causes outside the arc.

If, on the other hand, the direct-current arc be supplied by a dynamo, or if the arc circuit be placed so that there is mutual induction between it and leads carrying a dynamo current, then the long arc will give out a sound corresponding with the rate at which the dynamo segments pass the brushes. This explanation was, I believe, first suggested by Prof. Ayrton and Mr. Mather.

Intermittent Arcs.—If a direct or alternate-current arc be blown out by means of a jet of air or CO_2, or by means of a transverse magnetic field, it will, under suitable conditions, relight itself; and if the blowing be continued, the arc will be extinguished and relight itself again and again with great rapidity, giving out a harsh sound. The rapidity of these intermittances may be very great; M. Blondel* has found them to be as high as 3,000 to 4,000 per second in the case of the alternate-current arc, and M. Abraham† has obtained 100,000 per second in the case of the flame discharge.

It was suggested by Prof. Fitzgerald that this intermittance of the arc might be used to produce some high-frequency alternating current which I required. I therefore tried rendering a direct-current carbon arc, in series with a self-induction, intermittent by means of a magnet. With this arrangement the rate of intermittance was irregular and not very high, probably owing to the E.M.F. of my source of supply being too low, although E.M.Fs. up to 300 volts were employed.

In order to try and overcome this irregularity, I connected a condenser (about 5 mf.) between the terminals of the arc, when to my surprise I found that the direct-current arc was intermittent even when *not* blown in any apparent way either by a stream of gas or by a magnetic field, and, further, that no self-induction in series with the arc was necessary.

Here then was a puzzle—a direct-current solid arc burning under ordinary conditions with resistance in series, and supplied with current from accumulators, became intermittent and gave out a musical note on simply shunting the arc with a condenser.

Leads were, of course, employed to connect the condenser as a shunt to the arc, and on twisting these leads together so as to destroy the small amount of self-induction which they possessed I found that the musical note stopped, to be started again on

* The *Electrician*, Vol. xxxiv., p. 338.

* *La Lumière Electrique*, 1893, Vol. xliii., p. 54.
† *Société Française de Physique*, "Séances," 1899, ii. p. 70.

using the self-induction coil as the transmitting circuit. [Experi-

form some idea of the steepness of the curve A at the commence-

separating the leads; and on interposing in the condenser circuit a loose coil of wire, the sound was greatly magnified. Hence the true statement of the facts is that given below.

Musical Arc.—A direct-current arc of suitable length and current, between solid carbons, will give out a musical note if it be shunted with a condenser in series with a self-induction, as in fig. 9, even though the source of supply of the current be perfectly constant and the arc be protected as far as is possible from any outside cause of disturbance. [Experiment.]

I find that the musical note is produced by oscillatory currents flowing in the circuit composed of the condenser F, the self-induction L, and the arc, fig. 9, and its pitch is determined by the periodic time of this circuit—that is, by the relation between the capacity, self-induction, and effective resistance of the circuit. Neglecting the resistance, which it will be shown later must be small, the periodic time of the circuit $\tau = 2\pi\sqrt{LF}$, and this has been found, by judging the pitch of the note by ear, to be approximately correct, so that for lecture purposes Kelvin's law can by this means be easily demonstrated.

It must be remembered that although we have an alternate current through the condenser and self-induction, the source of supply is not an alternating one, and that *it is the arc itself which is acting as a converter, and transforming a part of the direct current into alternating, the frequency of which can be varied between very wide limits by altering the self-induction and capacity.* The upper limit I find to be about 10,000 ~ per second, and the lower limit, if such exists, is well below 500 ~ per second.

It has long been known that a train of oscillations of almost any frequency can be obtained on discharging a condenser through a suitable inductive resistance, but, of course, these oscillations have a rapidly decreasing amplitude, and the means of supplying energy to such a circuit, so as to maintain *the amplitude of the swings constant*, other than by means of a varying source of power having the same periodic time as the circuit, has been wanting. It is, therefore, necessary to inquire under what conditions it is possible for the arc to cause the source of direct current to supply the energy necessary to maintain the oscillations in the condenser circuit when once they have been started.

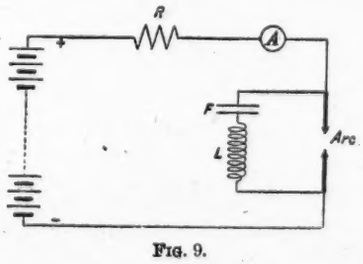


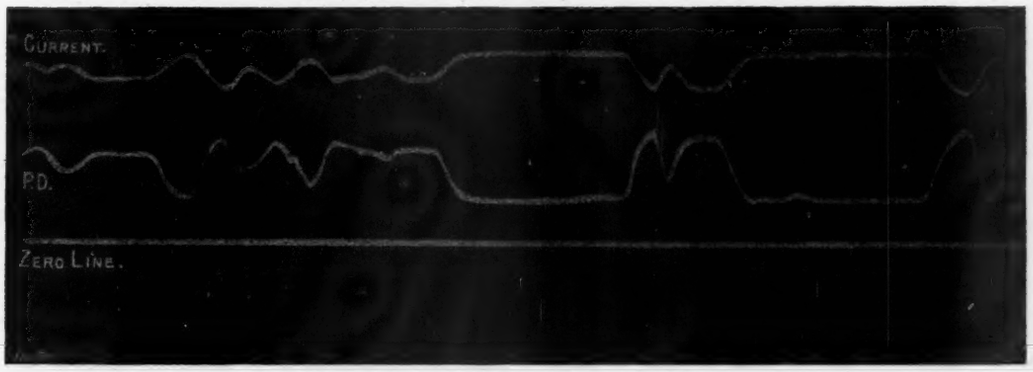
Fig. 9.

If the resistance in the main circuit in series with the arc is large, and if δ V be a small instantaneous change in the P.D. between the terminals of the arc, δ A the corresponding small change in the current through it, and r the resistance of the condenser circuit, not including the condenser; then, during the time this small change lasts, sufficient energy may be supplied to the condenser circuit to make up for the energy dissipated there, in ohmic losses, if the following conditions are fulfilled (see Appendix II.):—

1. $\frac{\delta V}{\delta A}$, negative.
2. $\frac{\delta V}{\delta A}$, numerically greater than r.

The question is, can the arc fulfil these two conditions? Messrs. Frith and Rodgers* have experimentally determined the value of $\frac{\delta V}{\delta A}$, which they call the resistance of the arc, for various arcs, and they found that while $\frac{\delta V}{\delta A}$ was always + when *both* carbons were cored, it was, on the contrary, always − when *both* carbons were solid, and that it was as small as −2 ohms for a 4-ampere solid arc. Now the resistance of the condenser circuit, r, external to the condenser, can easily be made less than 2 ohms, so that the arc can fulfil both the necessary conditions.

Very Short Hissing Arc.
Carbons + 11 mm., cored "Apostle"; − 9 mm., solid "Apostle."



Scales:— 1 mm. = 1·5 volt = 1·0 ampere = $\frac{1}{6100}$ second.

Fig. 8.

I will now describe some observations on the musical arc which tend to confirm the above conclusions.

Arcs between solid carbons for which $\frac{\delta V}{\delta A}$ is always negative *work well*, while those between *cored* carbons for which $\frac{\delta V}{\delta A}$ is positive I find *will not work* under any conditions. [Experiment.]

The largest negative value of $\frac{\delta V}{\delta A}$ given by Messrs. Frith and Rodgers is 2 ohms for a 4-ampere solid arc, and it is probable that it did not exceed 2·5 ohms for the smaller currents, viz., 3 to 3·5 amperes, which I used. According to the above conditions, 2·5 ohms should be the limiting resistance of the condenser circuit; by experiment it was found that when the resistance of this circuit was increased to 2·4 ohms, the oscillations stopped, and could not be restarted. [Experiment.]

It is evident that besides the resistance there are other causes, such as hysteresis, which tend to dissipate the energy in the condenser circuit, and stop the arc giving its note. The hysteresis in an iron-wire core introduced into the self-induction will instantly stop the note. [Experiment.] Any complete circuit such as a ring of wire placed near the self-induction has the same effect. [Experiment.]

On several occasions before the importance of these causes of the dissipation of the energy was realised, considerable trouble was experienced in tracing the reason of the arc failing to give its note. As examples, in one case it was traced to an ammeter, and in another to the tinfoil in the condenser, which were acting as short-circuited secondaries to the self-induction coil, which had been placed too near them. [Experiment.]

The relation between the self-induction, capacity, and frequency can be very easily demonstrated by playing a tune on the arc by varying either the capacity or the self-induction by means of a key-board. [Experiment.] Another method of varying the self-induction is by separating or bringing closer together the turns of the coil, as if playing on a concertina, the relative positions of the turns determining the self-induction and the pitch of the note. The musical arc can be used as a means of comparing self-inductions or capacities by comparing the pitch of the notes produced.

The "enclosed arc" will work equally as well as the open arc, though the note given out is not so audible, owing to the globe; but it can easily be made so by taking advantage of some of the telephoning effects mentioned in Part I.

The alternating current through the condenser circuit may be as large as from 3 to 5 amperes R.M.S. value, and the direct current in the main circuit also varies considerably, depending on the amount of resistance in the circuit. This condenser current is sufficient to show experiments with alternating currents which do not require much power, and is very convenient in many cases for lecture purposes, as the frequency, and any changes in it, are at once evident from the pitch of the note given out by the arc. Magnetic space telegraphy can easily be demonstrated on a small scale by

* *Proceedings of the Physical Society*, 1896, Vol. xiv., p. 307.

A very large ozone apparatus was shown in operation, for steri-

also a field in and around Paris, at least, for American methods of

using the self-induction coil as the transmitting circuit. [Experiment.] Several arcs can be used in series when more power is required in the condenser circuit than can be obtained from one arc alone.

For the convenience of those who may wish to repeat these experiments, I append a table of good working conditions for open and enclosed arcs. The exact figures need not be strictly adhered to, as the musical arc will work over a wide range of conditions. It may, perhaps, be well to mention that only condensers suitable for high voltages should be used, as although the P.D. arc is only 50 volts, the P.D. condenser rises to several hundred volts.

Table of Data of Musical Arcs.

	Open arc.	Enclosed arc.
Carbons both solid.	*Conradty.*	*Electra.*
Diameter	9 mm.	13 mm.
Arc length	1·5 mm.	1·0 mm.
Arc current	3·5 amperes	5 amperes
Resistance in series B	42 ohms	about 28 ohms
Self-induction of L	$5{\cdot}3 \times 10^{-3}$ h.	$5{\cdot}3 \times 10^{-3}$ h.
Resistance of L and leads ...	0·41 ohm	0·41 ohm
Capacity of condenser F	1·1 to 5·4 mf.	1·1 to 5·4 mf.
R.M.S. current through condenser when capacity = 5·4 mf. ...	3 amperes	4·5 amperes

Metal Electrodes Switch Contacts.—In connection with the above experiments the attempt was made to replace the carbons by metal electrodes, when I found that on trying to shunt the metal arc with a condenser it went out, no self-induction except that of the leads being used. [Experiment.] Of course, whether the arc is extinguished or not depends on the capacity used to shunt it, and on the other conditions of the circuit; thus, in the present case, with a 3-ampere arc between 6 mm. diameter copper electrodes and a resistance in series of from 50 to 60 ohms, it was found that the arc was always extinguished when shunted with a condenser having a capacity from 0·6 to 5·4 mf., though with the smaller condenser, 0·6 mf., and longer arc lengths the extinguishing was not quite so certain. Condensers larger than 5·4 mf. were not tried, though I have no doubt that they would prove even more effective.

This experiment is very instructive as showing how very soon the metal arc becomes practically non-conducting after the current through it is interrupted, for if we consider that the current through the arc is reduced to zero at the instant of first connecting the condenser, and remains zero unless the arc relights, then the time required for the 0·6 mf. condenser to charge up to $\left(1 - \frac{1}{e}\right)$, or 63 per cent. of the supply voltage, *i.e.*, 126 volts, is about $\frac{1}{27000}$th of a second. So that we may consider that if the current through the metal arc is interrupted for about $\frac{1}{27000}$th of a second, even applying about three to four times the normal voltage,* will not cause it to relight. This is very different from the case of the arc between cored carbons, for it is well known that the current through a 10-ampere cored arc may be interrupted by opening a switch in series with it for, say, a quarter-second, and yet the arc will relight on closing the switch again, owing to the high conductivity of the vapour left, when the arc is extinguished. The comparison is, however, not quite a fair one, as it might be expected that with the larger current, viz., 10 amperes used with the cored arc, more conducting vapour would exist than with the 3 amperes used for the metal arc, and that it would therefore take longer for the vapour column of a 10-ampere arc to cool down and attain a high resistance than that of a 3-ampere arc.

In order to make a fair comparison, the metal electrodes were replaced by cored carbons and a 3-ampere arc obtained under as nearly as possible the same conditions as the copper arc. This cored arc could not be extinguished even on shunting it with the largest condenser, viz., 5·4 mf. [Experiment], and it was found necessary, in order to make the cored arc go out on shunting, to reduce the current through it to below 1 ampere; but with such a small current the arc is rather unstable and liable to go out even when not disturbed in any way. Two solid carbons were also tried, and the effects were found to be intermediate between the cored arc and the metal arc, as a 2-ampere solid arc could just be put out by shunting with the 5·4 mf. condenser, whereas the 3-ampere metal arc always went out on being shunted with a condenser of as small a capacity as 0·6 mf., as already stated.

The correct method of finding out whether the arc will relight in any given case after it has been extinguished on suddenly reducing the current through it, is the following:—Let A, fig. 10, be a curve which might be drawn between the P.D. which will have to be set up between the electrodes to relight the arc, and the time that has elapsed since the arc was extinguished; and B the curve that connects the actual rise in P.D. between the electrodes (*i.e.*, between the condenser terminals) and the same time. Then the condition for the arc to relight is that the curve B touches or cuts the curve A.

Unfortunately we do not know much about the curve A between P.D required to relight the arc and time except that it starts from the P.D. at which the arc was burning at the instant it was extinguished, and attains a final constant value equal to the P.D. required to spark across between the electrodes. We can, however, form some idea of the steepness of the curve A at the commencement, for we know that, if the arc fails to relight, the curve A lies between the ordinate at the time of connecting the condenser and the curve B, that is the ordinate at time nought. The shape of this latter curve, which represents the P.D. between the terminals of the condenser during charge, can be calculated from the known data of

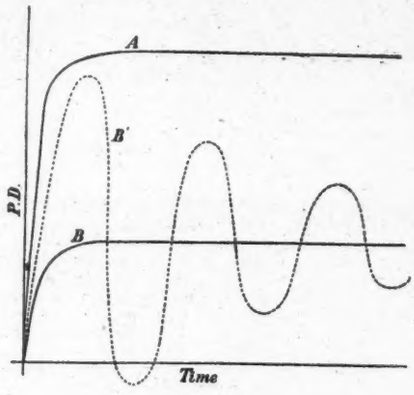


Fig. 10.

the circuit; thus with the copper arc mentioned above, which is just extinguished by shunting with a condenser of 0·6 mf. capacity, E.M.F. in circuit being 200 volts, resistance 56 ohms, and self-induction of leads neglected, the curve B will start with an initial steepness of about 6×10^6 volts per second. In spite of this very rapid rise of curve B, it will generally fail to intersect the curve A for the 3-ampere copper arc, so that the apparent resistance of the copper arc seems to increase at a very high rate after the current through it is stopped.

(To be concluded.)

* Direct-current metal arcs as above usually require a P.D. roughly about 30 volts.

THE PARIS EXPOSITION OF 1900.*

By CARL HERING.

(*Concluded from page* 1004.)

The telegraphone was one of the very few entirely novel inventions of promising value exhibited. This extremely ingenious and very interesting invention of Poulsen, a Dane, has been so thoroughly described in the journals that a mere mention will suffice here. It may be said to be a magnetic phonograph in which a long hardened steel wire is passed rapidly near the magnet of a telephone receiver, the magnetic variations of which are thereby recorded on it in the form of permanent magnetism. By then passing this wire under small pieces of iron attached to a diaphragm the same sounds are reproduced. I had the pleasure of hearing such a reproduction, and can vouch for the statement that it is much clearer than from an ordinary phonograph, as there is an entire absence of that objectionable scratching noise, there being no mechanical contact at all. Its suggested applications are numerous, including duplex and multiple telephony.

Those interested in the controversy between the vertical and the horizontal telephone switchboard found a good opportunity to compare them, as each was exhibited by its most ardent defender, the vertical board being advocated by one of our large and prominent companies, and the horizontal by a similarly prominent German company, which is introducing it in its country, notably in Berlin. The chief advantage claimed for the latter is that two operators sitting on opposite sides can use the same board, and that therefore the length of board for the same number of subscribers is halved.

Electro-chemistry was one the electrical classes in which the most pronounced recent development was shown, although the exhibits were not sufficiently complete to show the true state of that art. This branch of electrical science has opened what promises to be one of the important fields in which there is an opportunity for great development. Products which not many years ago existed only as rare and expensive specimens, and some which were not even known, are now made electrically by the ton.

Electric furnaces were shown in operation. There was also a very fine exhibition of the extremely interesting collection of products obtained by Moissan in his classical researches. Judging from two other large exhibits, copper is successfully deposited directly in the form of mechanically strong tubes, simultaneously with the process of electrolytic refining. A single company in Germany refines electrically about 5,100 ounces of gold and 24,000 of silver a day.

* Inaugural address by the President at the 147th meeting of the American Institute of Electrical Engineers, New York, October 24th, 1900.

make improvements. On the other hand, the typically European

extent of £700,000 was made in 1899. Of this sum £600,000 was

A very large ozone apparatus was shown in operation, for sterilising 200,000 cu. met. of water per 24 hours by the Marmier and Abraham process, but a confirmation of the claims made is very desirable.

The interesting process of Goldschmidt for obtaining very high temperatures of about 3,000° C. by the combustion of aluminium mixed with metallic oxides was well exhibited and deserves mention, although only of indirect interest to electricians. The expense of the aluminium naturally limits its application, but this seems to be more than balanced in some cases by the other advantages. It is already in commercial use for obtaining pure metallic chromium and manganese for the iron industry, and for welding rails and tubes, or mending broken iron parts.

In accumulators there was shown a general tendency, though not a universal one, to use Planté positives and Faure negatives, a combination which seems to have given the least trouble. Accumulators are now the rule and not the exception in Continental lighting and traction stations. Now that the fundamental patents have run out in this country, we ought to use them more freely here. As an electrical fly-wheel and a comforting reserve in a central station, the accumulator has no equal.

It is impossible, of course, from mere inspection, or from catalogue data, to judge of the success of the light weight accumulator for transportable purposes, notably for the automobile. But from the awards of the jury, which were based on reliable knowledge of their performance, the Fulmen, the Pulvis and the Phœnix were among the best of these; all three are French.

The most satisfactory development in primary batteries is that inventors—or perhaps the capitalists—seem to have at last been convinced that it is cheaper to burn coal than zinc.

A very interesting and promising method was shown in operation by its inventor, Rieder, for electrolytically engraving deep, hard steel dies, such as are used for pressing the reliefs on coins and for embossed work in general. A porous negative of plaster of Paris, saturated with chloride of ammonium, is lightly pressed against the steel blank and the metal is dissolved off electrolytically by a current, wherever the negative touches it. The cost is said to be only half that of the usual hand method.

The exhibitions of instruments were very fine, chiefly from France, England and Germany, but it would take too long to enter into a discussion of them here. That a d'Arsonval galvanometer is made with a sensitiveness of $1{\cdot}2 \times 10^{-10}$ amperes per mm. deflection, is of interest; it is claimed to be the highest sensitiveness yet reached with that type of instrument. Among the station and laboratory instruments which are not generally used in this country, but which are very convenient, are the phase meters of Dobrowolsky, indicating directly the difference in phase. A curious, but characteristically European criticism of a certain world-renowned type of American instrument, was that "they are bad, because they are expensive."

The very general introduction of micanite, an American invention, for generators and motors, is of interest.

The electric plant supplying the Exhibition did not seem to be a success, judging from the very numerous stoppages, and the excessive variations in the voltage.

The largest number of electrical exhibits were naturally from France. Among the foreign countries Germany was far ahead of all others in importance, and promises to become the leading manufacturing country for electrical goods in Europe, if it is not so already. One company alone employs 14,000 hands, and ranks with our largest American company. It is of interest to us that this successful company uses American methods quite largely. The Reichsanstalt, that creditable German institution, has no doubt contributed to the rapid strides made by that country in the electrical industries, and shows what Government aid can do for the industries of a country. England has already started its electrical standards laboratory of the Board of Trade, a very interesting and creditable government department, which was shown to our Institute this summer during its first official visit abroad. France has its "Central Laboratory," and is considering the enlarging of its Government department; Russia has a large Government electrical laboratory. The United States alone, among the large countries, has practically nothing of the kind.

Switzerland follows Germany in importance. The United States and England were inadequately represented in this department for reasons already mentioned, although there were some excellent exhibits from each. The lists in the catalogues cannot be taken as a guide in such a comparison, because a simple little device of no importance has the same prominence there as a large important exhibit of several thousand horse-power of machinery. Moreover, many American exhibitors who were entered in the catalogues, did not exhibit. In one class alone, the number of actual exhibitors was only 40 per cent. of that in the catalogue of the United States exhibits, and many of these were quite small. It would, therefore, not be just to judge the state of this industry in our country by the exhibits or by the awards.

A characteristic difference between American and foreign practice in manufacturing, for instance, such goods as dynamos and motors, is that here the manufacturer establishes certain well studied and well developed standard types and sizes of machines once for all, and then reproduces them in large numbers, making the parts interchangeable. The foreign manufacturer, on the other hand, constructs each machine according to the detailed specifications of the one ordering it. He argues that if he should make bids with standard sizes in stock, the purchaser would accept the bid of someone else who would construct the machines exactly according to the specifications. As a matter of fact, however, it was noticeable that those companies which have adopted the American method, were, as a rule, the most successful. There is also a field in and around Paris, at least, for American methods of managing and operating electric tramways, as existing practice is there very poor.

Another difference is that here the manufacturer, as a rule, devotes his whole effort to a single class of goods, and makes these in large quantities, while abroad he attempts to make a large range of widely different kinds of articles; this seems practical only when each branch is a large business in itself.

Still another difference is in the fine external finishing of even those parts of an apparatus which are concealed. Their argument is that all parts of a well-made apparatus ought to look well, and that it will then be handled with greater care and respect. Here we would consider it a useless expenditure of money to polish all the concealed mechanism of arc lamps, for instance. The foreigner, however, is apt to judge our goods from his standpoint, at least until he can be convinced of their advantages.

The Jury of Awards had many delicate questions to settle, both technical and diplomatic. While mistakes are possible, it is more than likely that complaints of exhibitors can generally be traced to unworthy or inadequate exhibits, or to circumstances beyond the control of the jurors. One half the jurors were French, and in the electrical group they were very liberal and generous to the foreign exhibitors, more so than to their own countrymen. If they erred at all, it was on the side of generosity, for which they deserve our thanks instead of abuse. Only two of the United States jurors for the electrical group were members of the Institute.

The Electrical Congress was an international gathering of about 1,000 engineers and scientists interested in the subject of electricity, and as a convention it was a great success, giving an opportunity of making many acquaintances and friendships among men of the same calling in widely different parts of the world. The French deserve great credit for its organisation and management. A large number of papers were read, varying in quality from very good to poor, reports of which have appeared, and are appearing, in the journals. The social features of the visits to the neighbouring electrical installations were well arranged and very enjoyable. Our Institute was represented by all of its six delegates, three of whom were elected officers of the Congress. All of the official United States delegates were members of the Institute.

As a gathering of official delegates appointed by the various Governments to settle questions concerning units, this Congress came very near accomplishing nothing at all. Had it not been for the efforts of two of the United States delegates, both members of our Institute, this very important feature of the Congress might as well have been omitted. It was due to the convincing appeals of our member, Mr. C. O. Mailloux, that the Chamber of Delegates reversed its former decision to take no official action on units and names, and adopted without a dissenting voice the recommendations of its committee, in which our Past President, Dr. Kennelly, ably represented our Institute. These adoptions were that the name of "gauss" be given to the C.G.S. unit of magnetic intensity or flux density, and "maxwell" to the C.G.S. unit of magnetic flux. The practical units will then generally be the kilogauss and the mega-maxwell. All the other propositions of the Institute were withdrawn in committee when it was found that they could not be adopted. The only other action taken by the official delegates was a unanimous expression of opinion that electrical energy should be considered as a property to be protected by law like any other.

The reason no further official action was taken concerning names and units, as suggested by the Institute, is, in the opinion of the writer, that our propositions were new to many of the delegates, not having been discussed fully in their different countries before the meeting of the Congress. At the International Congress of 1891, at Frankfort, when our Institute endeavoured, through its delegates, to have the names gauss and henry adopted, the reason for the failure was the same, and in the report of our delegates* it was recommended that in future our propositions should first be thoroughly discussed in the societies and journals of the different countries, leaving to the Congress only the final decision on well understood propositions. Had this recommendation been followed in the present case we might have accomplished still more. Any further recommendations of the Institute should be decided upon as soon as practicable and be made the subject of international discussion in the journals and societies in preparation for the next International Congress, whenever that may be.

The first meeting which our Institute held abroad was a memorable event, and bids fair to be the beginning of a series of international meetings of electrical engineers. It brought the Institute into considerable prominence abroad, increased its influence, and afforded great pleasure to those of its members who attended. When it was first suggested by a member of Council some years ago, to hold a meeting this year in Paris, the proposition was met with some ridicule, but its success, and the benefit the Institute derived from it, shows that the venture was not an unwise one, and that such meetings ought to be repeated. While we may have just pride in feeling that some branches of electrical engineering are better developed here than in other countries, and that our method of manufacturing certain classes of goods is superior, yet we should not forget that others who have worked equally hard in other countries often reach conclusions differing from ours, and which may well be worth our while to consider. Although our typically American practice of manufacturing standard types in large quantities and with interchangeable parts undoubtedly has great advantages, yet that is the very method which tends to retard development in those types, as it makes one hesitate, perhaps too long sometimes, to

* *Trans. Amer. I.E.E.*, Vol. 8, p. 546.

THE DEVELOPMENT OF THE ELECTRIC

attached to the truck of the car and provided at its lower end with

make improvements. On the other hand, the typically European method of building almost every machine differently gives an excellent opportunity for developing them, but precludes wholesale manufacture at reduced cost. Such International meetings, therefore, can hardly fail to be a benefit to all who take part, as they enable one to find, through personal observation and personal intercourse, that which is the best the world over, just as our home meetings bring before us the best in our own country. If we want to manufacture the best there is, especially if we want the foreigner to buy it from us, we should have international intercourse.

In London, our sister society, the Institution of Electrical Engineers, entertained us with true English hospitality for three well filled days, with a most delightful programme, in which pleasure and instruction were harmoniously combined. It will long be remembered by the 28 or 30 of our members who attended, as one of the most enjoyable features of the whole meeting. In Paris the official joint meeting with the British Institution, held in the National Pavilion of the United States, through the courtesy of Commissioner Peck, was well attended and was followed by receptions of both institutions, visits to objects of interest, and the Electrical Congress, making a total of two well filled weeks of international intercourse between electrical engineers, and constituting one of the most important meetings in the history of the Institute.

The success of our first meeting abroad should encourage us to follow the excellent example of the Institution of Electrical Engineers by making official visits to the different foreign countries to study their practice and examine their work. Our foreign colleagues will then be encouraged to visit our country, as many of them have promised to do next year on the occasion of the Pan-American Exhibition in Buffalo.

THE GERMAN ELECTRICAL ENGINEERING INDUSTRY.

(*Concluded from page* 966.)

The company's cable works on the Upper Spree were again extended, and have plenty of work, but complaint is made that, notwithstanding the high prices of raw copper and india-rubber, the pressure of competition prevents a corresponding rise in the price of cables. As far as the glow lamp factory is concerned, the production exceeded that of the previous year by over 1,000,000 lamps. The Nernst lamp has been tested in some of the small towns, and is now being introduced in Berlin, but the workpeople require properly training before it will be possible to turn out this type of lamp on a large scale. With regard to electric tramways, the company was interested in the construction of 70 lines, which are partly in operation and partly in progress, of a total length of 108 miles, and an equipment of 400 motor cars. At present 31 tramway plants are on order, and agreements have either been entered into or are in course of conclusion for a still larger number for the current year, including proposals for Buenos Ayres and Jassy. The report remarks further that 23 electricity works were either completed or extended during the year, and 26 others are either in course of construction or on order. It has already been mentioned that the company has undertaken contractor's work, and it should also be stated that it is also largely interested as an investor in numerous undertakings. These include the electro-chemical works at Bitterfeld and Rheinfelden, the Berlin Electricity Works, the Oerlikon Engineering Works, various tramways, and banks for the promotion of electrical enterprises. The number of workpeople employed by the company on October 1st, 1900, comprised 17,361, of whom 8,246 are engaged in the engineering works, 2,808 in the cable factory, 1,150 in the lamp factory, and the remainder in other departments.

The Elektricitäts Aktien Gesellschaft vormals Schuckert & Co., of Nuremberg, is another undertaking which stands in the front rank of German electrical engineering works. The growth of the undertaking will be understood from the fact that in order to cope with the increasing business, it was found necessary to increase the share capital of £900,000 in 1895 to £1,125,000 in 1896, to £1,400,000 in 1898, and to £2,100,000 in 1899, and the dividends paid were 14 per cent., 14 per cent., 14 per cent., 15 per cent. and 15 per cent. respectively during the five years. The ordinary capital has been supplemented by a bond issue of £1,000,000, half of which was raised over a year ago. As to the extent of the company's operations, it should be pointed out that the value of the output of the chief and branch establishments in Germany amounted to £3,850,000 in the past financial year as compared with £3,325,000 in the preceding 12 months, and the net profits were £462,451 and £320,901 respectively, or an increase of £141,550. Coming to consider the question of manufactures, the company's report notes that the number of dynamos and transformers constructed advanced from 6,330 of 234,000 H.P. in 1898 to 8,242 of 267,350 H.P. in 1899. The production of arc lamps increased by 25 per cent., measuring and controlling instruments by 20 per cent., and electricity meters by 75 per cent. An interesting reference in the report deals with the contentious question of depreciation. It is shown that the following percentages were written off for depreciation in accordance with the practice pursued in 1898:—Buildings, 2 per cent.; machinery, 10 per cent.; laboratory, 15 per cent.; tools, 25 per cent.; and patterns, 60 per cent. It has already been remarked that an increase in the share capital to the extent of £700,000 was made in 1899. Of this sum £600,000 was issued for the purpose of acquiring shares in the Continental Company for Electrical Enterprises, of Nuremburg. This transaction was completed last April, and the Schuckert Company now holds 28,820 shares in the Continental Company, to which reference may be made on a future occasion. As an investor the company is also interested in the Austrian Schuckert Company, the Rhenish Schuckert Company, and the British Schuckert Electric Company, the Russian Schuckert Company, the Compagnie Creil, and other undertakings. The report states that the business of the English company has been slowly developing, although it has been largely successful recently. During the past financial year numerous central stations were completely equipped by the company and machinery supplied to others, and in addition to Germany, plant was delivered for the Antwerp electricity works, the Athens Gas Company, the Madrid tramways, and the Turin tramways. At the present time many works are in progress, including the equipment of the tramways in Christiania, 4,000 H.P. for electro-chemical purposes in Italy, whilst the company has undertaken the construction of water-power plant for a Norwegian company at Kykkelsrud, where 50,000 H.P. is to be brought into industrial use. The company now employs 1,082 officials and 7,413 workmen in its German establishments.

The Union Elektricitäts Gesellschaft, of Berlin, which controls the Thomson-Houston tramway system in Germany, was first established in 1892 with a share capital of £75,000, and has a good record for a comparatively young company. In 1895 the capital was increased to £150,000, and in 1898, when the company acquired the electrical department of Messrs. Ludwig Loewe & Co., it was raised to £900,000. The company has paid a dividend of 12 per cent. in three successive years on a capital of £150,000, and the distribution for 1899 was 10 per cent. on £900,000. Since then it has been decided to issue further capital to the extent of £300,000, thus bringing the total to £1,200,000, and to raise a loan of £500,000 at the rate of 4½ per cent. It is understood that the company is intimately connected with Messrs. L. Loewe & Co., and the business of the former for the current year is characterised as satisfactory.

The Elektricitäts Aktien Gesellschaft vormals W. Lahmeyer and Co., of Frankfort-on-the-Main, appears to have made noteworthy progress since 1894, when a loss of about £1,000 was incurred on a share capital of £85,000. In 1895 a dividend at the rate of 5 per cent. was paid on that amount of capital; in 1896, when the capital had been raised to £117,500, the distribution was increased to 8 per cent.; in 1897, with a capital of £200,000, to 10 per cent. in 1898 to 11 per cent., and in 1899, when the capital was advanced to £300,000, the dividend paid also amounted to 11 per cent. The net profit for the past financial year reached £60,600, as compared with £37,334 in 1898. In April last it was decided to further increase the capital by an issue of £200,000, which has been subscribed by the shareholders and the Darmstadt Bank. With regard to the works carried out by the company during the past year, the report mentions the power installation completed at Henrichenburg on Dortmund-Ems canal, for the purpose of lifting vessels from one level of the canal to another. The utilisation of the gases from blast furnaces and coking ovens has also occupied attention, and installations were undertaken—one of 2,500 H.P. at the Rombach ironworks in Lorraine, and a second of 650 H.P. at the Marhirch ironworks in Alsace. A central station was equipped at Munster, Westphalia, with four gas engines each of 250 H.P., together with the necessary gas generating plant. This is the first municipal station which has been designed according to this system on such a large scale in Germany, and the installation is further noteworthy by reason of the operation in connection therewith of an electric tramway 5½ miles in length. Apart from the supply of plant for tramways and central stations in Germany, the company has gained a footing in Russia, where branches have been established in Moscow, Warsaw, and Kieff. The development of the business will, however, soon necessitate the formation of a separate Russian company in order to undertake the work in that country. A short time ago the company had in its employ 564 officials and 1,700 workmen. The latest information to hand is to the effect that the company has secured the contract for the supply of all the engines and electrical plant of 25,000 H.P. required by the Charing Cross and City Electric Lighting Company. It is reported that the order has been obtained in open competition between the leading firms in England, Germany, France, Belgium, Switzerland, and the United States.

The Helios Aktien Gesellschaft, of Cologne, has apparently not been so prosperous during the past year as in 1898, but this is probably due to the large increase in the share capital. Nearly a month ago, when the directors held a board meeting, it was stated that a net profit of £83,152 had been realised for 1899, as against £79,604 in the preceding year. In 1898 a dividend at the rate of 11 per cent. was paid on a capital of £400,000, whereas for the past year the distribution will be made on £750,000. It is announced that the distribution for the past year will be at the rate of 7 per cent.

Richmond.—The Corporation Tramway Committee will oppose proposals by the London United Tramways Company, for extensions in the borough, and recommends that when the time comes (in 1903) the Corporation should exercise its option to buy up the already existing lines in Richmond. The Esher U.D.C. have also decided not to consent to the local tramway proposals of the London United Company.

THE DEVELOPMENT OF THE ELECTRIC CONDUIT TRAMWAY SYSTEM.

Some interesting remarks on the historical side of the electrical conduit system have been recently contributed to the Brooklyn Engineers' Club by Mr. F. G. Cudworth. Not only are the historical facts of value, but some useful information is given concerning the construction of one or two of the conduit lines in America. The author goes so far as to assert that if it had not been for the stubborn and persistent refusal of the municipal authorities of New York City to consider any form of electric traction which contemplated the use of overhead wires, we should have had few experiments on underground construction after the disastrous failure on the West-End Road.

For some three or four years the New York City Tramways constructed a considerable length of line on the cable system, but apparently 25 miles of this system was sufficient to show that, in spite of the improvements in the cable, a system as large as that operating on Manhattan Island, with its gigantic power plants and underground vaults—many of these containing sheave-wheels a score of feet in diameter—can only be built and operated at a tremendous expense. It was recognised that the enormous cost of cable construction would alone limit its expansion, and the directors of the Metropolitan Street Railway Company cast about for some other form of mechanical traction which would equal, and if possible, be an improvement on the overhead trolley. As a matter of fact, the New York Company, after prolonged investigations, decided to adopt the conduit system, and one which was similar to that at Buda-Pesth, with certain modifications.

In the first two years of operation of the Lennox Avenue Road, certain mechanical faults were discovered, but after these had been rectified there was no further serious interruption of the service, although the road had been in continuous operation 24 hours a day. Snow gave much less trouble than was expected, and the author of the paper is of opinion that the conduit system can be operated under all climatic conditions without any more difficulties than will be met with in running any form of mechanically-operated road. It is stated that the design adopted by the New York Tramway Company has been too heavy, and in later extensions the heavy construction has been modified in a very marked degree. The tendency of the Metropolitan construction was towards a firm unyielding road-bed, while that adopted on the Third Avenue Road has been the opposite. The latter company, in its new construction, returned to the old form of a longitudinal stringer beneath the tram rail, and in the reconstruction of its old cable lines the company placed a stiff spring beneath the rail base to give elasticity to the road. It is claimed that it is a comparatively easy matter to construct a track for a steam or overhead trolley road, but when it becomes necessary to construct a longitudinal slot, the edge of which overhangs the support, and to maintain this slot at a uniform width under all conditions of temperature and traffic, the problem becomes extremely difficult.

Many of the common kinds of paving material, granite, wood, &c., expand to a considerable extent under different climatic conditions, and with a slot in the street the tendency is to expand in the direction of the slot, consequently it is necessary to construct the slot sufficiently strong to withstand this expansion. This has been provided for in the more recent construction by using a comparatively heavy yoke.

Certainly expansion is a serious matter, because the shank of the plough is $\frac{3}{8}$ inch thick, and the slot only $\frac{3}{4}$ inch, leaving a clearance of $\frac{1}{16}$ inch between plough and slot rail. In addition to this, the slot rail is subject to a heavy strain from loaded trucks passing over it; consequently the rail and yoke must be proportioned to meet these excessive strains without being deflected or closed up, and the foundations necessary to support these yokes must be of a most substantial character. In the track work adopted in New York City the yokes are placed 5 feet apart, centre to centre, every third yoke being a so-called box yoke; this is a cast-iron yoke made heavier than an ordinary yoke, and arranged to receive the insulators for supporting the conductor bars. The foundations are in all cases of concrete, usually 6 inches from the top to the base of the yoke, and tamped in around it in the same manner that ballast is used in steam railroad work. Feeder ducts are usually laid along the outside of the rails in connection with the track work, enough being put down to supply the present traffic and to provide, as far as possible, for future growth.

Manholes are built about every 400 feet to allow of connection being made with the feeder cables and the conductor bars. These manholes are generally about 5 feet wide and 4 feet deep, and are long enough to admit of repairs being made to the cables and for a new one to be drawn in when removing the street pavement. The conduit itself is connected with cleaning manholes at from 95 to 125 feet apart. In the earlier construction it was the common practice to place the cleaning manholes 200 feet or more apart, but it was found that the rapid accumulation of mud, which made it necessary to clean the conduit at least once a month in summer and oftener during the winter months, was so large that difficulty was experienced in pushing the same to the manholes. This was particularly the case with snow which, finding its way into the conduit, was softened by the difference in temperature, and in a number of cases packed hard enough to break the plough before it was pushed to the manhole. In operating the road, current is taken through a feeder cable to a T-shaped conductor bar. These bars are in 30-feet lengths, supported at each box-yoke every 15 feet by a heavy bottle-shaped insulator. The form of the plough has been previously mentioned in these columns; it consists of a steel shank attached to the truck of the car and provided at its lower end with two steel springs, to which are affixed cast-iron shoes shaped like a large spoon bowl. These shoes slide along the conductor bars, and take the current from the bar to the shoe. From the shoes insulated copper wires lead to the motor.

The path of the current is from the positive bar to the cast-iron shoe, thence along the insulated wire to the motor; through the motor to the wire on the opposite side of the plough, thence to the negative shoe and conductor bar. The conductor bars are divided into nine sections.

The weight of the rails used has been steadily increasing until at the present moment it has exceeded that used by steam roads. The weight in 1898 was 107 lbs. per yard for the tram rails, but this year a 60-feet girder rail, weighing 109 lbs. per yard, has been adopted, while that used for the reconstruction of the Broadway cable is a 71-feet girder weighing 107 lbs. per yard. It appears that cast-weld joints have been used between the rails, and are said to have made a marked difference in the ease of riding. The cost of the cast-weld joint is stated to be roughly 18s., which includes cleaning the rail with the sand blast and furnishing all material necessary to properly weld it.

Including the cost of excavating and relaying round the joint brought the total up to £1 9s., this at the present market price of steel rail in New York being a little more than half the cost of replacing with a new rail.

The author concludes by saying that as regards the cost of underground conduit construction, it is almost impossible to give an intelligent answer, owing entirely to the local conditions. This is especially true in New York City, where account must be taken not only of numerous sub-surface obstructions, such as pipes, drains, sewers, &c., that must be taken up and relaid, but entire streets in a large number of cases have to be repaved. All this abounds when the extremely high price of special work tends to bring the average cost per mile of single track to about £18,000, including feeders Out side of New York City, where there are lots of stringent rules relating to the relaying of old pavements, and where there are less sub-surface obstructions, the underground electric conduit system can be installed for £7,000 to £10,000 per mile of single track, but the actual cost per mile of single track under the New York Construction has been as high as £30,000, while special work at junctions has cost much higher. In one case it cost for special work alone close on £14,000, and in one instance one double cross over and two double track turn-outs actually cost £19,000.

CURRENT SPECIFICATIONS.

XLII.—LEEDS LIGHTING STATION EXTENSION PLANT.

Summary.

Scope of Tender.—Two 1,400-kw. two-phase steam alternators, and one separate surface condensing plant capable of dealing with the exhaust steam from a 2,000 i.h.p. engine.

Type of Engine.—Engine may be either (*a*) vertical compound running at not more than 85 revolutions per minute; (*b*) vertical triple-expansion running at either about 85 or 200 revolutions per minute.

Important Factor in determining Choice of Plant.—Small floor space occupied, the size of engine-room being limited, and great importance being attached to accommodating the greatest number of units.

Steam Pressure Available.—If compound engines are selected, 150 lbs. per square inch; if triple-expansion, 170 lbs. per square inch.

Emergency Load of Plant.—1,540 kw. = 10 per cent. overload, for a period of two hours.

Normal Load of Plant.—1,400 kw. at 2,100 volts at normal speed. The plant to be capable of developing full load when power factor of external circuit = 0·8.

Type of Alternator.—To have stationary armature and revolving field magnets, both mounted on iron cores.

Position of Alternator.—To be placed end-on to the engine with independent bearings.

Periodicity of Circuit.—50 ~ per second.

Specified Temperature Rise.—Not to exceed 45° F. above surrounding atmosphere after 12 hours' continuous running on a non-inductive load of 1,400 kw., or 70° F. after 6 hours' continuous running at 1,400 kw. on a circuit having a power factor of 0·8. Temperature rise to be measured thermometrically immediately after stopping the machine.

Range of Regulation.—Not to exceed 6 per cent. between no load and full load with constant speed and excitation on non-inductive load, or 20 per cent. on an inductive load having a power factor of 0·8.

Voltage Variation.—The variations in voltage between the two windings when one is fully loaded and the other open-circuited must not exceed 3½ per cent.

Fly-wheel Effect.—To be stated by tenderer in his offer.

Exciter.—To be shunt-wound, of ample capacity, and direct coupled to alternator.

Condensing Plant.—To be of surface type, with not less than 3,400 square feet of cooling surface, and steam-driven air and circulating pumps.

Steam Consumption Guarantee.—To be stated by tenderer in his offer.

read by every engineer who has a storage battery under his

theoretical work and heat units, using the generally accepted

Specified Date of Completion.—Fifteen months from date of order.
Penalty for Late Completion.—One-half per cent. per week on contract sum for either steam alternators or condensing plant.
Period of Maintenance.—Nine months from date of completion.
Terms of Payment.—80 per cent. during progress on value of plant delivered and work executed on site; 10 per cent. three months after plant has been taken over by Corporation; 10 per cent. six months later.
Stipulations as to Wages Paid to Workmen.—Unsatisfactory.
Stipulations as to Removal of Foreman.—Satisfactory.
Arbitration Clause.—Unsatisfactory, see comments below.
Date for Receipt of Tenders.—January 5th, 1901.

This is the second time during the present year that the Leeds Corporation have been in the market for generating plant. In May they issued specifications for two 630-KW., two-phase 50 ~ steam alternators, and now two 1,400-KW. sets are required for delivery within 15 months from date of order. Both specifications have been prepared by the electrical engineer to the Corporation, Mr. H. Dickinson, A.M.I.C.E., M.I.E.E., and from the technical standpoint there is little difference between them. The principal ones are that not only triple-expansion vertical high speed engines, but also vertical low speed, either triple-expansion or compound, may be offered. In the case of high speed plant, 200 revolutions per minute is the limit, in the case of low speed, 85 revolutions per minute is specified. The permissible temperature rise is also lower; in place of 60° F. after 12 hours continuous working at normal full load, 45° F. is specified on a non-inductive circuit, and 70° F. after a similar run at normal load on a circuit having a power factor of 0·8.

The special attention which Mr. Dickinson pays to good results on inductive circuits having low power factors, proves his belief in the suitability of two-phase currents for motor work, and it will be interesting to note whether this anticipation will be realised.

In the previous specification, a steam consumption of 26 lbs. per K.W.-hour at full load, was asked for under a bonus or penalty of *£200* per 1 lb. of steam per KW.-hour. No figure is specified at the present time, but tenderers are asked to state the figure they will guarantee under a *bonus* or *penalty* of *£400* per 1 lb. of steam per KW.-hour, or *pro rata* for parts of a pound.

A number of details respecting the construction and anticipated performance of the generating units are asked for, and must be sent in with the tender.

The general conditions have been considerably altered from those issued with the last specification, and commented upon in our issue of May 25th last.

We then criticised the arbitration clause which, by reason of its limited application, we deemed very inadequate. In the present contract, even this has been withdrawn, and the engineer is made the sole arbiter in case of dispute.

To enable our readers to appreciate the present position, we print the two clauses :—

As in use last May :—

In case any dispute or difference whatsoever shall at any time or times hereafter arise or exist between the contractor and the Corporation touching their respective rights or obligations under the said contract, or the fulfilment or non-fulfilment thereof or incident thereto, other than such matters as are herein specifically directed to be referred to or decided by the engineer as mentioned, *such dispute or difference shall from time to time*, at the instance or request of either party, *be submitted to and decided by the arbitration of two arbitrators, one to be nominated by the contractor and the other by the Corporation*, and the proceedings under and consequent upon the said last-mentioned reference shall be conducted, and any award or awards to be made thereunder shall be subject to and be governed, conducted, and affected by all the incidents, consequences, and effects of a reference to two arbitrators under the provisions of the Arbitration Act, 1899.

As now proposed :—

In the event of any difference of opinion, doubts or disputes arising respecting the meaning or intention of the drawings or specification, or these conditions or the contract, or any part or parts thereof respectively, or respecting the quality of the materials, matters, and things to be supplied by the contractor, or the execution of the work or any part or parts thereof respectively, or *respecting any other matter or thing whatsoever arising out of or incidental to the contract, the same shall be and are hereby referred to the engineer, whose award, order, and decision shall be final and binding on both parties*, and the submission hereby made shall not be revoked by either party hereto, *and may be made a rule of any Divisional Court of Her Majesty's High Court of Justice, at the instance of either party to the contract, and either party to the contract may instruct counsel to appear and consent to such rule on behalf of either party.*

The differences will be seen at once. We do not know the reasons which have influenced the Corporation in making the change, but we consider their present attitude quite unjustifiable, and we strongly recommend all tenderers to stipulate for the insertion of an unlimited arbitration clause in the final contract.

In our remarks upon the labour clauses, which have not been altered, we pointed out that if they were rigidly enforced they would press unfairly upon the British manufacturer, who could be sued for any breach of them, whereas his foreign competitor was not. We are pleased to see that in the present instance it is distinctly stated in the advertisement, "*Preference will be given to tenders for plant of British manufacture.*"

These clauses were reprinted in full in our issue of May 25th, and we refer our readers to that issue. Those most objectionable are, however, the following :—

(*e*) The foregoing conditions shall not apply to any trade or trades during the existence of a general lock-out in such trade or trades. *The Corporation shall be the sole judges as to whether such a general lock-out exists.*

(*e*) *The contractor shall, to the satisfaction of the Council, provide and keep proper books, in which shall be correctly and promptly entered from time to time the names of, the wages paid to, and the hours of labour observed by, all workmen* employed by him, whether in or about the execution of the contract or otherwise, and *shall* from time *when required by notice in writing* under the hand of the town clerk *produce the same or any of them to him or the deputy town clerk, who shall be at liberty to inspect and take copies of or extracts therefrom.*

(*g*) *In case of any breach by the contractor or by any person to whom the contract or any part thereof or interest therein may be transferred, assigned, or underlet* of any one or more of the stipulations in this clause contained, it shall be lawful for the Council to determine the contract in the same manner, and to the same extent, as they have power to determine the same under Clauses 8, 16 and 29 of these stipulations in the events therein specified; and if the contract shall be determined under this present power, then all the provisions of those clauses shall apply as if the contract had been determined under those clauses.

In the event of any repairs being necessary during the period of maintenance, the clause referring thereto is so worded, that the onus of proof of cause of damage rests with the absent contractor. We do not consider this just; while the contractor ought to be liable for faults due to defective workmanship or material, the onus of proof should rest with the purchaser, subject, if disputed, to the decision of the arbitrator. The clause reads :—

The contractor shall guarantee the soundness of all the work, and shall at his own cost and charge keep the same in good and efficient order, repair, and condition until the final payment shall be due, and shall make good all defects which may appear in the work, and take the risk of all accidents and damages arising therefrom that may occur during that period, and shall, from time to time, upon an order in writing from the engineer, immediately repair, restore, or make good such work to the complete satisfaction of the engineer and the Corporation. If such repairs are not executed within seven days after such order, the Corporation may execute the required work in any mode they may deem advisable, and reimburse the Corporation out of any money due to the contractor, or recover the amount of such expenses by action at law. *If, however, the contractor shall satisfy the engineer that the defect or repair is due to some ascertained cause other than a defect of construction, workmanship or material, the cost shall be borne by the Corporation.*

The remaining clauses, though in part slightly more stringent than the old ones, are not of such a character that serious objection may be taken to them, though doubtless the careful tenderer will ask that some of them may be slightly modified if his offers are recommended for acceptance.

REVIEWS.

The Lead Storage Battery. By Desmond G. FitzGerald.

The storage battery has long been an important adjunct to every well-designed lighting or power plant, either public or private, yet there is no part of the installation of which the average engineer has less knowledge, and consequently the battery does not receive the same amount of intelligent care and attention that is given to the other portion of the plant, with the result that it suffers in consequence.

Everything, therefore, which helps to the better knowledge of the theory and construction of the storage battery must be welcome, and it would be well if this book were

read by every engineer who has a storage battery under his control, as in any case it would teach him the combinations and reactions which take place during the working of the battery, and must impress upon the reader why careful treatment is necessary in order to ensure the best results.

The title of the book ("The Lead Storage Battery: its History, Theory, Construction and Use") represents a very wide subject, and full justice could scarcely have been done to it in a book containing only 380 pages; but as there is but little said in its pages concerning the use of the storage battery, and very little, except a few patent specifications, on its construction, the book really deals chiefly with the history and theory of the lead storage battery, and its title might well have been shortened in this sense. It is mentioned on the title page that the book is illustrated, but, if we except diagrams, which can scarcely be called illustrations, we find that the whole of the book contains only three illustrations.

A good table of contents is given at the commencement of the volume, which shows at a glance the matter touched on in the various paragraphs and chapters. This table also indicates that the arrangement of the paragraphs has not been very well thought out. As an instance, although in Chapter I. the weight and thickness of active material is discussed, and even local action explained, it is not till Chapter II., p. 22, that any description is given of the methods in which the various forms of plates are made, or that any idea is given to the reader of the nature of the essential parts of which a storage battery consists. Three-fourths of the printed matter is taken up by the discussion, or rather by the description, of the various theories which have been advanced from time to time as to the exact chemical reactions which take place in batteries during charge and discharge, and the reader is thus given an insight into the work of Gladstone and Tribe, Frankland, and others; to this is added a number of interesting experiments made by the author personally, and which are probably given here for the first time. The book is essentially one written from the point of view of a chemist, or, at any rate, of a writer who is only dealing with the laboratory side of the question; the reader is reminded of this continually throughout the book; in fact, it appears to be its most serious defect that, although the various theories in connection with the chemical and physical properties of batteries are for the most part carefully set forth and clearly explained, no consideration is given to mechanical structure or strength of the plates, and very little to the various details necessary in order to make the storage battery a useful commercial article. Further than this, the book appears in some points to presuppose a considerable knowledge of secondary batteries by the reader, yet, on the other hand, parts of it are severely elementary in character, such, for instance, as the calculation of the number of plates in a given receptacle, or when the author says the number of plates should be an odd one. For the reason mentioned above, it follows that a very large amount of chemical knowledge is assumed, rather more, in fact, than the average engineer can be expected to possess.

Pp. 220—236 are given up to discussion on the nature and properties of celluloid and its chief component, pyroxylin. This appears to be a somewhat large amount of space to devote to such a subject, since it is now generally admitted that this substance is unsuitable for use in storage batteries. This section of the book ends with a couple of pages on the treatment of inventors, which, however important from the author's point of view, is surely a personal matter which would have been better omitted, as it certainly does not essentially belong to the problems connected with the lead storage battery. While mentioning this subject, it may be well to point out that p. 40 also contains a personal paragraph which would have been better omitted. These form serious blemishes, and should surely be removed in any subsequent editions of the book.

On pp. 190 to 193 is given an account of an interesting experiment, made under the supervision of the author, on an affluidic electrolyte. Unfortunately the experiments were not continued sufficiently far to give any conclusive result, merely showing that during the initial stages, at any rate, the ordinary acid is very much superior to the affluidic electrolyte.

Chapters VIII. and IX. are devoted to the discussion and calculation of the E.M.F. of the storage battery from the theoretical work and heat units, using the generally accepted values of calorific equivalents. The author fails altogether in fitting his theoretical figures to practical results, even although he places the average electromotive force of a cell discharged from 2 to 1·85 volts at 1·93 instead of 1·96 volts. The possible explanation given is far from convincing, and it would perhaps be better to concede that the figures given in the table of kilocalories on p. 139 are probably incorrect for storage battery problems, being obtained under conditions which do not occur in such cells. The question of the nature and density of electrolyte is touched on in various parts of the book, yet, considering the importance of this subject and its bearing both on the reactions which take place and the E.M.F. of the cell, it does not seem that it has received the attention which it deserves.

On p. 154 the writer shows that it is due to the late Sir Edward Frankland that the specific gravity method for indicating the state of charge of a battery is adopted. Yet on p. 310 he implies that this was due to Sir William Preece. The writer also takes the specific gravity for the fully charged E.P.S. cells as 1·190, whereas, according to the company's instructions, it should be from 1·200 to 1·210.

The last few chapters give descriptions of several well-known traction cells at present maufactured in America and on the Continent. The descriptive matter is, however, of a very limited nature. These chapters also contain data of such cells illustrated by curves showing the ampere-hours per pound of plate, and per pound of cell at various rates of discharge, all of which are compared with standard E.P.S. lighting cells. Unfortunately these curves, and, in fact, the figures generally, are not accompanied by the necessary details to allow the reader to judge of their value, for, as the author himself points out on p. 261, such details as total number of plates, distance apart, size of plates, are very essential in order to make such comparisons of any value. Apparent discrepancies in the figures given would probably be removed if fuller details were added. The part of the book dealing with the history of the several companies formed to manufacture various types of cells is interesting, although on one of the companies, at any rate, the author's comments appear to be very severe.

It is difficult to understand why the author calls the Faure-King cell, manufactured by the E.P.S. Company, the "Faure-Thomassi" cell. Further, the Marchenay patent (mentioned as being 1895, instead of 1885) is not the first dealing with cells manufactured by what is known as the Chloride method, as F. Maxwell Lyte described this form of cell in his patent in 1883.

Why the private correspondence between the author and Sir W. H. Preece has been published on pp. 200 and 201 is somewhat of an enigma, as surely it has no bearing on the subject.

On p. 198 the author speaks of the internal resistance being *diminished* by the use of the semi-fluid electrolyte of M. Lambotte; this should be *increased*.

From this brief survey it will be seen that while the book is not without faults which will doubtless be removed in subsequent editions, yet it has its sterling good qualities. It has already been said it should be in the hands of every engineer who has anything to do with storage batteries; it can be confidently placed in the hands of advanced students who already have some acquaintance with the subject and some knowledge of chemistry, and to the specialist it should prove valuable, both in giving concisely many of the theories already advanced and also as a guide to show in what direction further investigation is likely to produce good results.

The binding and paper are scarcely as good as might be expected in a book of this character.

The "Mechanical World" Pocket Diary and Year Book for 1901.

The fourteenth issue of this excellent publication has been increased in size, and the section on electrical transmission of power has been considerably amplified, extending now to polyphase current working. The clear wording, and the quantity of information condensed into a small space, make this section highly creditable to the compiler. Moreover, we

have observed no mistakes or inaccuracies of any consequence therein. We need not say that we strongly recommend this well-known pocket-book to our readers.

Fowler's Mechanical Engineer's Pocket-Book, 1901. By W. H. Fowler, Wh.Sc., A.M.Inst.C.E. Manchester: Scientific Publishing Company.

In a previous review of this handbook we pointed out a large number of errors in the electrical section; many of these have been rectified in the present issue. Of the more important that remain, the substitution of α for $\theta - \alpha$ on p. 281, the misprints "voltameter" for "voltmeter" on p. 225, and the incorrect temperature formula on p. 196 are the chief. The use of the sign $\propto$ in mistake for α (pp. 196—198) is more amusing than misleading; a similar slip is γ for r on p. 229. The Aron meter section remains apocryphal, but for the remark that the clocks are now made self-winding. The air-gap ampere-turns calculation on p. 236 is still wrong, and the formula for eddy currents on p. 293 is misprinted, as also is that for the resistance to traction, p. 331.

There are still innumerable typographical errors which greatly mar the section; but on the whole the section is better, and is much less amusing than it was. No great additions have been made to the book, the total number of pages being unaltered.

The "Practical Engineer" Electrical Pocket-Book, 1901. Manchester: The Technical Publishing Company, Limited.

This useful pocket-book has been re-issued in good time for the new year; it has been considerably extended, various tables having been added and others revised. We regret, however, to see that the errors pointed out in our review of the first edition remain for the most part unrectified. The knot is still a length instead of a velocity; the watt is 44¼ foot-pounds; the three-wire system is again libelled, being placed among methods of wiring, and credited with only half its economy of copper. In the moving coil galvanometer, the currents are said to vary as the *tangents* of the deflections. Energy is referred to in watts on p. 66. The standard temperature of "Her Majesty's ohm" is misprinted as 85·4° instead of 15·4° C.

Besides those previously pointed out, we have noticed several other mistakes; but we do not propose to waste space upon them, seeing that the corrections are not made. Errors in a first edition are inevitable; their repetition in later editions is inexcusable.

The "Practical Engineer" Pocket-Book, 1901. Manchester: The Technical Publishing Company, Limited.

This excellent annual has been revised and several additions made, including the Civil Engineers' recommendations on the standard of efficiency of steam engines; notes and tables on the temperature-entropy diagram; a table of multipliers for the initial, mean, and terminal pressures of steam for a wide range of expansions; and various other useful tables. We can have no hesitation in cordially recommending this well-known book to our readers.

The Practical Electrician's Pocket-book and Diary, 1901. By H. T. Crewe, M.I.M.E. London: S. Rentell & Co., Limited.

This is the third annual issue, revised and enlarged, of this neat little handbook. The index is still wanting, the contents table being very inadequate to take its place. We regret to see that the definitions of electrical terms remain uncorrected, except in one or two instances. One cannot repose entire confidence in a book which errs in its very fundamental propositions. A large amount of information on all branches of electrical industry is given, including some useful notes on the erection of various systems of wiring. The book cannot fail to be useful to a large number of electricians, and the detachable printed forms are likely to be very serviceable.

Manual of Electrical Undertakings, 1900-1901. By Emile Garcke.

Mr. Garcke's admirable manual is a most valuable publication for all who are interested in the electrical industry, particularly its financial side. Everything of any consequence in relation to electricity supply, traction, manufacturing, telegraph and telephone purposes, companies and also municipalities is most conveniently arranged for ready reference. The manual has now reached its fifth year, and the 1900-1901 edition before us naturally contains much more information than those of previous years. As the industry grows, such publications must also grow with it, but although there are some hundreds more pages than in the last edition, the book is less bulky, as a thinner paper is used.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

We have already devoted so much space to the equipment and doings of the Electrical Engineer (Royal Engineer) Volunteers, and chronicled the tools and tackle with which the contingent has rightly earned such fame in South Africa, that we hardly need to repeat what most of our readers already know. An abstract of Lieut.-Colonel Crompton's lecture delivered at the Institution of Civil Engineers' theatre to the members of the Institution of Electrical Engineers on the evening of Thursday last appears in another column of this issue, and gives the most generally interesting portion of that address and narrative. As delivered, the lecture gained much from the fact that we learnt from the lips of the leader of the contingent how the time was spent, the class of work done, and the difficulties encountered and overcome. True, this was not the first occasion on which the same tale was told, but such a good and true story will bear repetition.

In our last issue we recounted some of the things said at the dinner and at the formal reception of the South African contingent. Much of this of necessity was repeated on Thursday, and the lantern slides naturally covered the same ground, but the electrical profession cannot know too much about, or appreciate too well, what use was made of the members of their own vocation on the veldt and kopjes of the Orange River Colony and the Transvaal.

After the lecture had concluded, Mr. Alex. Siemens moved a resolution of congratulation to the members of the contingent, taking much the same line as he did at the dinner, and emphasizing the fact that he knew something of the class of work that had been faced, for he had to go through something similar himself some 30 years ago. He was followed by Mr. Hugo Hirst, who briefly sketched the history of the war, and alluded to the electrical work as having been done by an adjunct to the adjunct of the regular army, but that the electrical work of the future in the regions traversed by our troops would be no adjunct, but a serious battle with the forces of nature, and electrical engineers would take one of the most important parts. He closed with an appeal to employers to help any of the men who had returned to civil life, should there be any requiring the truest kind of assistance, giving them a place in electrical employment.

To Mr. J. W. Swan again fell the honour of reminding the meeting that not all those who left had returned to this country, and in touching and moving terms he alluded to the four men who had died at the post of duty and who had served their country in a good cause to the last, thereby achieving immortality. He put the resolution of sympathy with the relatives of the four deceased sappers in a frame of words, such as few would have chosen so well.* Sir Henry Mance seconded, in a few well-chosen sentences, pointed with the reminder that he had two sons serving in South Africa, and, therefore, knew something of the feelings of those whose

* We might wish that the younger members of the Institution of Electrical Engineers would learn from their older friends in the "Civils," and in future receive a motion of condolence *sub silentio*. To applaud such a motion (as was done on Thursday) is hardly in the best of taste, and merited a rebuke from the chair.

kinsmen were serving the country so far away. He had been many years an officer in the Volunteers, and was one of the oldest electrical engineers in that force. He thought the resolution might prove some consolation to relatives who had lost their friends; and having witnessed some partings at Southampton, gave the opinion that those who made the greatest sacrifices were the wives and mothers of those who so nobly went forth on behalf of their country.

The President, amidst applause, stated that it was the intention of the Council to have the congratulatory resolution engrossed and sealed and sent to the members of the contingent. The resolution of condolence is to be communicated by the secretary of the Institution to the relatives of the deceased men.

The suggestion was made—and will, we trust, be acted on—that Col. Crompton should be asked to allow a selection of the slides shown on the screen to appear with the reprint of the lecture in the *Journal* of the Institution. What we think is really wanted is a full, but concise and readable account of the contingent's composition, equipment, and work, so that it may be preserved for future reference, embodied in a rather more permanent and get-at-able form than is possible with references scattered throughout the technical press, and for this purpose the *Journal* seems just the thing.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1900.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

22,433. "Improvements in metallic conduits for electric light cables and the like." L. M. Waterhouse and The Simplex Steel Conduit Company. Dated December 10th.

22,434. "Improvements in metallic conduits for electric light cables and the like." L. M. Waterhouse and The Simplex Steel Conduit Company. Dated December 10th.

22,452. "Improvements in automatic potential regulators for dynamos." N. Browne. (The Tirrill Regulator Company, United States.) Dated December 10th.

22,476. "Improvements in staples for electric wires." H. A. Litz. Dated December 10th.

22,484. "Improvements in prepayment electricity meters." E. Schattner. Dated December 10th.

22,503. "Long quick-break spring contact switch." F. Atkinson and W. Atkinson. Dated December 11th.

22,508. "Electrical resistance switch." J. Cusworth. Dated December 11th.

22,509. "Protector for sparking plugs of motors." C. H. Guset. Dated December 11th.

22,515. "An automatic trolling contact for electric bells." A. B. Mudie. Dated December 11th.

22,542. "Improvements in means for supporting electric lamps." A. Richter Dated December 11th.

22,546. "Improvements in electrical interrupters for gas engines." T. Bergmann. Dated December 11th. (Complete.)

22,572. "Improvements in or relating to electrostatic machines." K. Schall. (Reiniger, Gebbert & Schall, Germany.) Dated December 11th.

22,584. "An electric furnace with two bed plates." C. A. Keller. (Date applied for under Patents, &c., Act, 1883, Sec. 103, May 21st, 1900, being date of application in France.) Dated December 11th. (Complete.)

22,585. "Improvements in flexible supporting structures for electric lamps." W. F. Brewster. Dated December 11th. (Complete.)

22,599. "Improvements in the manufacture of incandescence bodies for electric glow lamps." A. Just and R. Falk. Dated December 11th.

22,605. "Improvements in and relating to plate holders for electric accumulators." T. Muller. Dated December 11th. (Complete.)

22,606. "A process for chemically consolidating the active material of electric accumulators." T. Muller. Dated December 11th. (Complete.)

22,607. "Improvements in or relating to electric accumulator cells." T. Muller. Dated December 11th. (Complete.)

22,623. "Improvements in electric or electro-pneumatic organs." R. Hope-Jones. Dated December 12th.

22,662. "Process for the manufacture and repair of electrical glow lamps." F. Blau, A. Scharf, I. Loti, S. Loti, and R. Latzko. Dated December 12th.

22,679. "Improved means applicable for use in operating and controlling electrically-propelled trains or tramcars." S. H. Short. Dated December 12th.

22,678. "Improved means applicable for use in transmitting energy to electrically-propelled trains or tramcars." S. H. Short. Dated December 12th.

22,680. "Improvements in electric current switching apparatus." R. P. Wilson. Dated December 12th.

22,690. "Improvements relating to electrical traction." K. J. McMullen and J. A. McMullen. Dated December 12th.

22,692. "Improvements in or relating to electric ignition devices for explosion engines." C. Osborn and The British Motor Traction Company, Limited. Dated December 12th.

22,698. "Process of extracting and reducing metals by electrolysis." H. A. Frasch. Dated December 12th. (Complete.)

22,703. "Improvements in the electrolytic refining of copper." S. Cowper-Coles. Dated December 13th.

22,704. "Improvements in the construction of induction coils." W. E. Ayrton and W. Duddell. Dated December 13th.

22,712. "Protective device for galvanometers and the like." A. Whalley. Dated December 13th.

22,713. "Improvements in electric switches and fuses." A. Whalley. Dated December 13th.

22,731. "Increasing the efficiency of high tension induction electrical machines of the Wimshurst Voss, &c., type." F. Tudsley. Dated December 13th.

22,747. "Improvements in electro-magnetic brakes." F. L. Clark. (Date applied for under Patents, &c., Acts, 1883, Sec. 103, May 14th, 1900, being date of application in United States.) Dated December 13th.

22,748. "Improvements in electro-magnetic brakes." F. L. Clark. (Date applied for under Patents, &c., Act, 1883, Sec. 103, May 14th 1900, being date of application in United States.) Dated December 13th.

22,753. "Improvements in and relating to backing or holding blocks for stereotype and electrotype plates." J. H. Simpson and E. W. H. Walker. Dated December 13th.

22,775. "An improved arrangement of cut-outs and apparatus for the better protection of electric cables and generators." Callender's Cable and Construction Company, Limited, and J. O. Callender. Dated December 13th.

22,779. "Improvements in mounting telephonic instruments and accessories so as to admit of interchanging or renewal of the various parts." M. Byng and F. G. Bell. Dated December 13th. (Complete.)

22,788. "Improvements in joints for earthenware pipes or conduits, and in the means employed for producing the same." H. L. Houlton and C. E. Morris. Dated December 14th.

22,798. "Improvements in automatic switches." A. H. Mayes. Dated December 14th.

22,801. "Improvements connected with electric lamps." W. McGregor Douglas. Dated December 14th.

22,819. "Improvements in high tension electric fuses." A. Eckstein and A. J. D. Krause. Dated December 14th.

22,824. "System of distribution for independent polycyclic electric currents." E. Arnold, O. S. Bragstad, and J. L. La Cour. Dated December 14th.

22,848. "Improvements in arc lamps." J. D. F. Andrews. Dated December 14th.

22,851. "The automatic electric post." E. L. Gordon. Dated December 14th.

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2. "Improvements in apparatus for connecting electric mains." J. S. Highfield. Dated January 22nd, 1899. Junction boxes for electric mains are formed in three parts, of which one part is trough-shaped to receive a cable, the second part is an upper chamber for the branch connections, and the third part is the lid. The first is divided by partitions, and has a liner where a connection is desired. After the connection is made, the first part is filled with insulating material, and is closed with a cover through which the connection passes. The branch is led in through a gland filled with insulating material, and may have a separate terminal, the branch and main terminals being connected by a fuse. Two forms of main terminals are described. In one form, a loop is passed under the cable and secured by screws to a rod. In the second form, the loop embraces the cable, and has a divided taper screw for engaging with a female screw in the end of a rod. 3 claims.

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have observed no mistakes or inaccuracies of any consequence therein. We need not say that we strongly recommend this well-known pocket-book to our readers.

Fowler's Mechanical Engineer's Pocket-Book, 1901. By W. H. Fowler, Wh.Sc., A.M.Inst.C.E. Manchester: Scientific Publishing Company.

In a previous review of this handbook we pointed out a large number of errors in the electrical section; many of these have been rectified in the present issue. Of the more important that remain, the substitution of a for $\theta - a$ on p. 281, the misprints "voltameter" for "voltmeter" on p. 225, and the incorrect temperature formula on p. 196 are the chief. The use of the sign $\propto$ in mistake for a (pp. 196—198) is more amusing than misleading; a similar slip is γ for r on p. 229. The Aron meter section remains apocryphal, but for the remark that the clocks are now made self-winding. The air-gap ampere-turns calculation on p. 236 is still wrong, and the formula for eddy currents on p. 293 is misprinted, as also is that for the resistance to traction, p. 331.

There are still innumerable typographical errors which greatly mar the section; but on the whole the section is better, and is much less amusing than it was. No great additions have been made to the book, the total number of pages being unaltered.

The "Practical Engineer" Electrical Pocket-Book, 1901. Manchester: The Technical Publishing Company, Limited.

This useful pocket-book has been re-issued in good time for the new year; it has been considerably extended, various tables having been added and others revised. We regret, however, to see that the errors pointed out in our review of the first edition remain for the most part unrectified. The knot is still a length instead of a velocity; the watt is 44¼ foot-pounds; the three-wire system is again libelled, being placed among methods of wiring, and credited with only half its economy of copper. In the moving coil galvanometer, the currents are said to vary as the *tangents* of the deflections. Energy is referred to in watts on p. 66. The standard temperature of "Her Majesty's ohm" is misprinted as 85·4° instead of 15·4° C.

Besides those previously pointed out, we have noticed several other mistakes; but we do not propose to waste space upon them, seeing that the corrections are not made. Errors in a first edition are inevitable; their repetition in later editions is inexcusable.

The "Practical Engineer" Pocket-Book, 1901. Manchester: The Technical Publishing Company, Limited.

This excellent annual has been revised and several additions made, including the Civil Engineers' recommendations on the standard of efficiency of steam engines; notes and tables on the temperature-entropy diagram; a table of multipliers for the initial, mean, and terminal pressures of steam for a wide range of expansions; and various other useful tables. We can have no hesitation in cordially recommending this well-known book to our readers.

The Practical Electrician's Pocket-book and Diary, 1901. By H. T. Crewe, M.I.M.E. London: S. Rentell & Co., Limited.

This is the third annual issue, revised and enlarged, of this neat little handbook. The index is still wanting, the contents table being very inadequate to take its place. We regret to see that the definitions of electrical terms remain uncorrected, except in one or two instances. One cannot repose entire confidence in a book which errs in its very fundamental propositions. A large amount of information on all branches of electrical industry is given, including some useful notes on the erection of various systems of wiring. The book cannot fail to be useful to a large number of electricians, and the detachable printed forms are likely to be very serviceable.

Manual of Electrical Undertakings, 1900-1901. By Emile Garcke.

Mr. Garcke's admirable manual is a most valuable publication for all who are interested in the electrical industry, particularly its financial side. Everything of any consequence in relation to electricity supply, traction, manufacturing, telegraph and telephone purposes, companies and also municipalities is most conveniently arranged for ready reference. The manual has now reached its fifth year, and the 1900-1901 edition before us naturally contains much more information than those of previous years. As the industry grows, such publications must also grow with it, but although there are some hundreds more pages than in the last edition, the book is less bulky, as a thinner paper is used.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

We have already devoted so much space to the equipment and doings of the Electrical Engineer (Royal Engineer) Volunteers, and chronicled the tools and tackle with which the contingent has rightly earned such fame in South Africa, that we hardly need to repeat what most of our readers already know. An abstract of Lieut.-Colonel Crompton's lecture delivered at the Institution of Civil Engineers' theatre to the members of the Institution of Electrical Engineers on the evening of Thursday last appears in another column of this issue, and gives the most generally interesting portion of that address and narrative. As delivered, the lecture gained much from the fact that we learnt from the lips of the leader of the contingent how the time was spent, the class of work done, and the difficulties encountered and overcome. True, this was not the first occasion on which the same tale was told, but such a good and true story will bear repetition.

In our last issue we recounted some of the things said at the dinner and at the formal reception of the South African contingent. Much of this of necessity was repeated on Thursday, and the lantern slides naturally covered the same ground, but the electrical profession cannot know too much about, or appreciate too well, what use was made of the members of their own vocation on the veldt and kopjes of the Orange River Colony and the Transvaal.

After the lecture had concluded, Mr. Alex. Siemens moved a resolution of congratulation to the members of the contingent, taking much the same line as he did at the dinner, and emphasizing the fact that he knew something of the class of work that had been faced, for he had to go through something similar himself some 30 years ago. He was followed by Mr. Hugo Hirst, who briefly sketched the history of the war, and alluded to the electrical work as having been done by an adjunct to the adjunct of the regular army, but that the electrical work of the future in the regions traversed by our troops would be no adjunct, but a serious battle with the forces of nature, and electrical engineers would take one of the most important parts. He closed with an appeal to employers to help any of the men who had returned to civil life, should there be any requiring the truest kind of assistance, giving them a place in electrical employment.

To Mr. J. W. Swan again fell the honour of reminding the meeting that not all those who left had returned to this country, and in touching and moving terms he alluded to the four men who had died at the post of duty and who had served their country in a good cause to the last, thereby achieving immortality. He put the resolution of sympathy with the relatives of the four deceased sappers in a frame of words, such as few would have chosen so well.* Sir Henry Mance seconded, in a few well-chosen sentences, pointed with the reminder that he had two sons serving in South Africa, and, therefore, knew something of the feelings of those whose

* We might wish that the younger members of the Institution of Electrical Engineers would learn from their older friends in the "Civils," and in future receive a motion of condolence *sub silentio*. To applaud such a motion (as was done on Thursday) is hardly in the best of taste, and merited a rebuke from the chair.

kinsmen were serving the country so far away. He had been many years an officer in the Volunteers, and was one of the oldest electrical engineers in that force. He thought the resolution might prove some consolation to relatives who had lost their friends; and having witnessed some partings at Southampton, gave the opinion that those who made the greatest sacrifices were the wives and mothers of those who so nobly went forth on behalf of their country.

The President, amidst applause, stated that it was the intention of the Council to have the congratulatory resolution engrossed and sealed and sent to the members of the contingent. The resolution of condolence is to be communicated by the secretary of the Institution to the relatives of the deceased men.

The suggestion was made—and will, we trust, be acted on—that Col. Crompton should be asked to allow a selection of the slides shown on the screen to appear with the reprint of the lecture in the *Journal* of the Institution. What we think is really wanted is a full, but concise and readable account of the contingent's composition, equipment, and work, so that it may be preserved for future reference, embodied in a rather more permanent and get-at-able form than is possible with references scattered throughout the technical press, and for this purpose the *Journal* seems just the thing.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1900.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

22,433. "Improvements in metallic conduits for electric light cables and the like." L. M. Waterhouse and The Simplex Steel Conduit Company. Dated December 10th.

22,434. "Improvements in metallic conduits for electric light cables and the like." L. M. Waterhouse and The Simplex Steel Conduit Company. Dated December 10th.

22,452. "Improvements in automatic potential regulators for dynamos." N. Browne. (The Tirrill Regulator Company, United States.) Dated December 10th.

22,476. "Improvements in staples for electric wires." H. A. Litz. Dated December 10th.

22,484. "Improvements in prepayment electricity meters." E. Schattner. Dated December 10th.

22,503. "Long quick-break spring contact switch." F. Atkinson and W. Atkinson. Dated December 11th.

22,508. "Electrical resistance switch." J. Cusworth. Dated December 11th.

22,509. "Protector for sparking plugs of motors." C. H. Guset. Dated December 11th.

22,515. "An automatic trolling contact for electric bells." A. B. Mudie. Dated December 11th.

22,542. "Improvements in means for supporting electric lamps." A. Richter Dated December 11th.

22,546. "Improvements in electrical interrupters for gas engines." T. Bergmann. Dated December 11th. (Complete.)

22,572. "Improvements in or relating to electrostatic machines." K. Schall. (Reiniger, Gebbert & Schall, Germany.) Dated December 11th.

22,584. "An electric furnace with two bed plates." C. A. Keller. (Date applied for under Patents, &c., Act, 1883, Sec. 103, May 21st, 1900, being date of application in France.) Dated December 11th. (Complete.)

22,585. "Improvements in flexible supporting structures for electric lamps." W. F. Brewster. Dated December 11th. (Complete.)

22,599. "Improvements in the manufacture of incandescence bodies for electric glow lamps." A. Just and R. Falk. Dated December 11th.

22,605. "Improvements in and relating to plate holders for electric accumulators." T. Muller. Dated December 11th. (Complete.)

22,606. "A process for chemically consolidating the active material of electric accumulators." T. Muller. Dated December 11th. (Complete.)

22,607. "Improvements in or relating to electric accumulator cells." T. Muller. Dated December 11th. (Complete.)

22,623. "Improvements in electric or electro-pneumatic organs." R. Hope-Jones. Dated December 12th.

22,662. "Process for the manufacture and repair of electrical glow lamps." F. Blau, A. Scharf, I. Loti, S. Loti, and R. Latzko. Dated December 12th.

22,679. "Improved means applicable for use in operating and controlling electrically-propelled trains or tramcars." S. H. Short. Dated December 12th.

22,678. "Improved means applicable for use in transmitting energy to electrically-propelled trains or tramcars." S. H. Short. Dated December 12th.

22,680. "Improvements in electric current switching apparatus." R. P. Wilson. Dated December 12th.

22,690. "Improvements relating to electrical traction." K. J. McMullen and J. A. McMullen. Dated December 12th.

22,692. "Improvements in or relating to electric ignition devices for explosion engines." C. Osborn and The British Motor Traction Company, Limited. Dated December 12th.

22,698. "Process of extracting and reducing metals by electrolysis." H. A. Frasch. Dated December 12th. (Complete.)

22,703. "Improvements in the electrolytic refining of copper." S. Cowper-Coles. Dated December 13th.

22,704. "Improvements in the construction of induction coils." W. E. Ayrton and W. Duddell. Dated December 13th.

22,712. "Protective device for galvanometers and the like." A. Whalley. Dated December 13th.

22,713. "Improvements in electric switches and fuses." A. Whalley. Dated December 13th.

22,731. "Increasing the efficiency of high tension induction electrical machines of the Wimshurst Voss, &c., type." F. Tudsley. Dated December 13th.

22,747. "Improvements in electro-magnetic brakes." F. L. Clark. (Date applied for under Patents, &c., Acts, 1883, Sec. 103, May 14th, 1900, being date of application in United States.) Dated December 13th.

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22,753. "Improvements in and relating to backing or holding blocks for stereotype and electrotype plates." J. H. Simpson and E. W. H. Walker. Dated December 13th.

22,775. "An improved arrangement of cut-outs and apparatus for the better protection of electric cables and generators." Callender's Cable and Construction Company, Limited, and J. O. Callender. Dated December 13th.

22,779. "Improvements in mounting telephonic instruments and accessories so as to admit of interchanging or renewal of the various parts." M. Byng and F. G. Bell. Dated December 13th. (Complete.)

22,788. "Improvements in joints for earthenware pipes or conduits, and in the means employed for producing the same." H. L. Houlton and C. E. Morris. Dated December 14th.

22,798. "Improvements in automatic switches." A. H. Mayes. Dated December 14th.

22,801. "Improvements connected with electric lamps." W. McGregor Douglas. Dated December 14th.

22,919. "Improvements in high tension electric fuses." A. Eckstein and A. J. D. Krause. Dated December 14th.

22,834. "System of distribution for independent polycyclic electric currents." E. Arnold, O. S. Bragstad, and J. L. La Cour. Dated December 14th.

22,848. "Improvements in arc lamps." J. D. F. Andrews. Dated December 14th.

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216. "Improvements in electric railways of the sectional conductor type." J. G. Lorrain. (T. C. Esmond, United States.) Dated January 4th, 1899. Relates to electric railways and tramways of the sectional conductor type with electro-magnetic switches. To prevent sticking of the switches which connect the main supply conductor with the sectional conductor, a second armature or switch lever in each switch is attracted to close a circuit between earth, and an additional contact in a previously excited switch and the main current then blows the fuse. The arrangement is applicable to other forms than that particularly described. 4 claims.

356. "Improvements in the manufacture of incandescent materials and lamps suitable for electric lighting." L. W. Gans. Dated January 6th, 1899. Relates to incandescent lamps. An incandescent rod or tube is moulded from an earthy oxide, fired, and partly coated externally or internally with a highly-infusible metal such as iridium, rhodium, ruthenium, or osmimum, prepared as a ceramic lustre; the rod or tube is then heated in a muffle containing hydrogen or other reducing gas to a high temperature. Such an incandescent body can be either exposed to the air or enclosed in a bulb, which is exhausted or contains an indifferent or reducing gas if osmium is used in the metal coating; no auxiliary heating is necessary. The oxide used may be lime, baryta, strontia, magnesia, thoria, ceria, ziconia, or the like, or a mixture, and may be mixed with water and about 1 per cent. of silicic, boric, or phosphoric acid to render it coherent when moulded. Tubes may be 5 to 15 millimetres long, with walls 1 to 5 mm. thick, and 2 or 3 mm. internal diameter. The provisional specification describes the support and connection of such bodies by platinum wires inserted in, or foils surrounding their ends, which are coated with iridium, &c. It also refers to Specification No. 17,896, A.D. 1898, which describes making metallic conductors from ceramic lustres, and coating them with oxides. 1 claim.

405. "Improvements in jacks used in combination with electrical annunciators or indicators for the replacement of the shutter or signal flag." A. Eckstein and R. P. Eidsforth. Dated January 7th, 1899. The indicators, shutters, or signals flags are released by an electro-magnet through a lever and when in position complete a local bell circuit. The shutter is replaced by inserting the plug, which, pressing aside the spring contact draws the stirrup and spring to the left, and the spring, by acting on the hub of the shutter, replaces it in its horizontal position. 4 claims.

416. "Improvements in electrical heaters or resistances." A. Barman. Dated January 7th, 1899. A heating resistance consists of a nickel-steel, manganin, or other metallic ribbon extended in parallel lengths, or doubled and coiled on a glass plate, and embedded in a dry insulating powder in a flat metal case which has a flanged lid secured by bolts. The case and lid may be ribbed externally. The insulating material may be talc, or a mixture of silicic acid, clay, oxide of iron, and magnesia, with a little lime. The provisional specification mentions the use of such apparatus for drying purposes, or in connection with electric lamps. 4 claims.

882. "Improvements in electric arc lamps." W. Crudgington. Dated January 16th, 1899. Relates to arc lamps. Carbon electrodes are mounted in a sealed glass globe, which is highly exhausted after previous filling with nitrogen, carbon monoxide, or other indifferent gas, to prevent consumption of the electrodes and increase the production of light. The upper carbon may be carried by the core of a series coil, which strikes the arc. The provisional specification mentions the use of platinum instead of carbon electrodes. 1 claim.

974. "Improved prepayment electricity meter for continuous or direct currents whose action depends on decomposition of copper in a balance against silver coins." E. F. Terrey and C. H. J. Phillips. Dated January 16th, 1899. Consists of a balance with electrodes dipping into cells and mercury contacts circuited so that the overweight of a coin in one bucket directs the current to transfer material from the nearer electrode and deposit it on the further one till equilibrium is re-established. The next coin paid is dropped into the other bucket, which is indicated by a rocking pointer. 3 claims.

1,044. "Improvements in switches for electro-motors and the like." R. A. Sloan and J. E. L. Barnes. Dated January 16th, 1899. Relates to switches for motors. The regulating and main switches are so interlocked that the main switch cannot be closed except when the regulating switch is in the starting position, and the latter cannot be moved until the main switch is free to open. In one arrangement the loose handle of the double-pole quick-break switch carries a projection adapted to interlock with a segmental piece carried by the handle of the regulating switch. In the starting position, the main switch can be closed, but the regulating switch cannot be moved until the handle has been moved back, and then the main switch is ready to be opened by an overload or like device. The provisional specification states that electro-magnetic releasing devices and fuses are combined with the main switch to open it in case of over or underload. 3 claims.

1,047. "Improved construction of straight and curved underground conduits for enclosing electric conductors, haulage cables, and other means of communication, allowing connection of vehicles, sledges and moving bodies to same, and allowing access below." G. W. Sutcliffe. Dated January 17th, 1899. Relates to conduits for electric and rope railways and tramways applicable for all haulage and communication are arranged with an upper conduit chamber without any transverse webs and having a central groove through which the connection to the vehicle passes. The conduit opens underneath into an antechamber with strengthening webs. Underneath the whole is the inspection conduit, of large size, which may be employed for various purposes, such as containing gas and other pipes. The central groove may be divided longitudinally, and in the case of points, switch-plates may be pivoted at the sides of the chamber so as to open and close one or other of the converging grooves, the edges of the plates being shaped to conform to the groove that is opened. The plates are also provided with lugs for attachment to the switch lever. 4 claims.

1,087. "Improvements in regulable electric resistances." F. W. Schindler. Dated January 17th, 1899. Wire resistances are embedded in a ring of firebrick or like material, on which a metal casing is cast to enclose it except where connecting wires are brought out to contacts. The contacts and a rotary arm are carried by a metal plate which is attached to the casing by three lugs and screws, with suitable intervening material to prevent transmission of heat. The cases containing the resistances may thus be replaced if damaged. In a modification the plate and casing are in one piece, the refractory body containing the resistances being removable from the casing. 2 claims.

1,106. "Improvements in and relating to facia for electrical instruments." M. Byng and R. P. Eidsforth. Dated January 17th, 1899. Letters and numerals are printed with coloured grounds on metal face plates, or strips of any shape, for electrical instruments, such as indicators and voltmeters, by lithographic or other ordinary processes for printing in two or more colours. 2 claims.

1,141. "A method of and means for deriving two or more alternating currents of different phase from a source of single-phase electrical supply." H. A. Wagner. Dated January 17th, 1899. Relates to obtaining two or more alternating currents of different phase from a single-phase source. A phase difference is obtained in one of the branches by the insertion of an inductive resistance, and the required phase difference in the other branches is obtained by suitably connecting them with points of different potential. One of the branch circuits is connected to a suitable point of the secondary of the transformer, an inductance being inserted in another branch. 8 claims.

1,156. "Improvements in current collecting apparatus for electric tramways." C. W. G. Little and A. G. Ireland. Dated January 18th, 1899. Relates to electric railways and tramways with overhead conductors. To aid in replacing the trolley on the conductor, a guiding fork or horns pivoted on the head is raised to the position shown in dotted lines by a cord, &c. Gravity or coiled springs lying in recesses in the head cause it to drop when out of use. 4 claims.

1,188. "Improvements in guards for overhead electric conductors such as trolley wires and the like." P. L. Jones. Dated January 18th, 1899. Overhead wires, such as used in electric railways, &c., are provided with wooden guards, these are attached to the wires by two part screw clamps. Lengths of the guards are held together by clamping bands fitting in grooves so as to surround the upper portion only. Terminal supporting bands are of similar construction but have one of the ends of the band lengthened to form a hook. 5 claims.

1,230. "Improvements in lighting trains by electricity." C. P. Eliason and W. S. Hayler. Dated January 18th, 1899. Relates to train lighting in which a dynamo is driven from one of the axles. Means are provided for maintaining an approximately constant electromotive force at the lamp terminals, and for maintaining the constant direction of flow of current, the apparatus is arranged in the bottom of a vehicle. The dynamo is driven from the axle by belt gearing, the belt preferably consisting of iron links hinged together, and running on pulleys faced with leather or the like. The drum of a resistance switch is operated through chain or other gearing by a centrifugal or other governor mounted on the shaft. In a modified arrangement, the resistance switch connects a series of tumblers operated in succession. The switch serves to increase the resistance when the speed rises above a limit. A switch makes or breaks the armature circuit when the speed of the dynamo reaches the limits for which it is set. It is geared to the resistance switch, and operates when that is in certain positions. Two sections are bolted together, and form a mercury chamber. Contacts are so arranged that the circuit is completed when the apparatus rotates on its bearings. It is so mounted on its operating shaft that it has a tumbler action. The chamber is preferably exhausted, an aperture being provided for this purpose. The circuit is only connected when the dynamo reaches a certain speed, and is broken when the speed is excessive. The accumulators supply the lamps when the dynamo circuit is broken. The reversing switch consists of a disc or drum loosely mounted on the shaft and fitted with suitable contacts. On the reversal of the dynamo it tends to turn with it until it meets a stop. In another arrangement, the disc is oscillated by an electro-magnetic device. In another modified arrangement, the dynamo is fitted with two pairs of brushes, one pair acting when the dynamo is running in one direction and the other pair in the reverse. The brushes are carried by pivoted levers connected to the cores of an electro-magnet. The provisional specification states that the resistance switches, &c., may be operated pneumatically, the piston being operated from a moving part or a governor. It is also stated that the lamps may be lighted in the day, when passing through a tunnel, by a projection on the train striking a projection on the line. 7 claims.

1,434. "Improvements in electric telegraph apparatus." S. G. Brown. Dated January 21st, 1899. Relays for telegraph systems such as those used in submarine working are arranged with the swinging coil carrying or connected to a fixed arm or fixed and movable arms which bear on the divided periphery of a rotating drum, the two sides of which are arranged in the divided battery circuit. The drum may have two pairs of conducting discs or may be arranged horizontally when it is undivided; two horizontal drums may also be used. Several arrangements of submarine signalling are described, the essential feature of which consists in the employment of an inductive resistance having a closed magnetic field. The resistance may or may not be adjustable, and may have an exciting circuit to bring the magnetic core to near its saturation point. 7 claims.

1,438. "An electric mechanism for driving turret and other clocks." S. D. Nolil. Dated January 21st, 1899. The pendulum drives a ratchet wheel which, having pins, serves as the "make and break" for electro-magnetic ratchet gear driving the hands. The electro-magnetic ratchet gear may have a hooked driving pawl and a controlling pawl, or it may have a pushing pawl which acts when the circuit is open. 7 claims.

1,467. "Improvements in electric light wire casing." A. Davidson. Dated January 23rd, 1899. Wooden grooves casings are formed with a metal, preferably steel, strip. The cover may be metal-lined or the metal may form the cover by itself. 2 claims.

1,493. "Apparatus for heating by electricity." P. John. Dated January 23rd, 1899. Resistant wire is coiled on a strip or cord of a refractory insulating material, and placed between insulating strips, on asbestos or enamel lining the interior of a metal casing. The coils are covered by an insulating sheet upon which the wire ends are attached to flexible leads by twisting and clamping them between pairs of washers on eyelets. These joints are covered with a second insulating sheet and a metal plate which is secured by a bolt, the flexible leads passing through insulating bushes in the metal plate. When alternating current is used the strip may contain an iron core, to give additional heat due to eddy currents. The casing may have three feet and serve as a radiator or heater. Ovens, saucepans, and other cooking apparatus, and irons for branding, pressing clothes, or other purposes may be similarly heated. A tailor's iron may have a spring switch in the handle, adapted to be closed by pressure of an insulating stem carried on a spring under the handle when the iron is lifted, to connect additional heating wire in parallel with coils which are permanently connected. The switch may otherwise be normally closed, but opened when the iron is placed on a stand by engagement of projecting parts of the switch and stand. 7 claims.

1,673. "Improvements in portable telephones, applicable also for testing purposes." H. F. Blackwell, jun., and M. A. Blackwell. Dated January 24th, 1899. Portable telephones for use on fire or police telegraph systems, or for testing purposes, are arranged in a box case provided with a bail for hanging up. The case contains a transmitter, induction coil, battery, condenser, receiver, and plug. The condenser is connected in the receiver and plug line so as to make a telephone earth connection without disturbing the system signalled over; the second plug contact completes the receiver circuit through the secondary of the induction coil to line. The receiver has the coil contained in a metal thimble connected to the rear end of the core. A contact spring is mounted in the case for completing the microphone and battery circuit when signalling. 3 claims.

1,687. "Improved electrical apparatus for operating mechanism at a distance." W. P. Thompson. (J. S. Thompson.) Dated January 24th, 1899. Relates to arrangements by which a number of keys at a transmitting station can selectively actuate any electro-magnet, of a series arranged in parallel across the leads, so as to operate a number of devices such as type-writer keys (printing telegraph), signals, or the like. One arrangement, in which a number of keys are connected to the lines by a generator and a rheostat so that each key of the series taken in order sends a decreasing current to line, is described. The receiving electro-magnets are arranged to act with a similarly decreasing amount of current, but, as the current decreases, the time constant of the magnet increases. The armature of each magnet may directly operate the respective devices, or may control local circuits. Each armature in acting cuts out the following magnets by breaking one of the contacts and by closing the circuit cuts in a resistance equal to the line resistance of the magnets cut out. A battery may take the place of the generator and rheostat, and the receiving magnets may be wound either of wire of varying thickness or of even thickness wire but varying in amount of turns. 9 claims.

1,758. "Improvements in portable hand dynamos, parts of which improvements are applicable to small power dynamos and motors for other purposes." Evershed and Vignoles, Limited, and S. Evershed. Dated January 25th, 1899. Relates mainly to portable hand dynamos adapted for testing purposes, but the improvements are also applicable in part to small power dynamos and motors generally, to exploders for firing electric fuses, and to small motors used in some forms of electric supply meters. The machines are preferably of the type provided with permanent field-magnets, but shunt or series wound magnets may also be employed. The armature may be of the drum or ring type, preferably the former, and in order to obtain a high electromotive force it is wound with as many diametrical coils as a convenient number of poles in the periphery of the core will allow, and each of these coils is connected to one of a series of two-part commutators placed alongside one another on the armature shaft. The commutators consist of a number of deep and narrow washers, each divided into two parts by radial slots and mounted on a sleeve of insulating material, with insulating distance pieces between them. Each commutator is provided with a pair of disc brushes, all of which are connected in series. Each brush consists of a pair of thin metal discs with concentric corrugations. These are mounted side by side on a metal cylinder supported in a standard, and receive the commutator segments between them. For multi-sectional commutators, single disc brushes set obliquely may be employed, *e.g.*, in a motor meter. The armature spindle is driven by a handle either directly or through speed gearing, the moving parts being provided with ball or roller bearings. The handle is pivoted to a sleeve on the driving shaft, so that it can be folded over into a recess in the side of the containing box. It is held in its operative position by a knob detent, which engages with an eye formed by a pair of spring arms. A double terminal piece fitting into a recess in the side of the box is provided with a cord conductor passing round a spring drum in the cover of the box, and connected through a peripheral ring and the base plate of the drum to the hinges of the box, and through these to the brushes. When the terminal piece is drawn out, the spring drum is prevented from returning it by a pawl. 8 claims.

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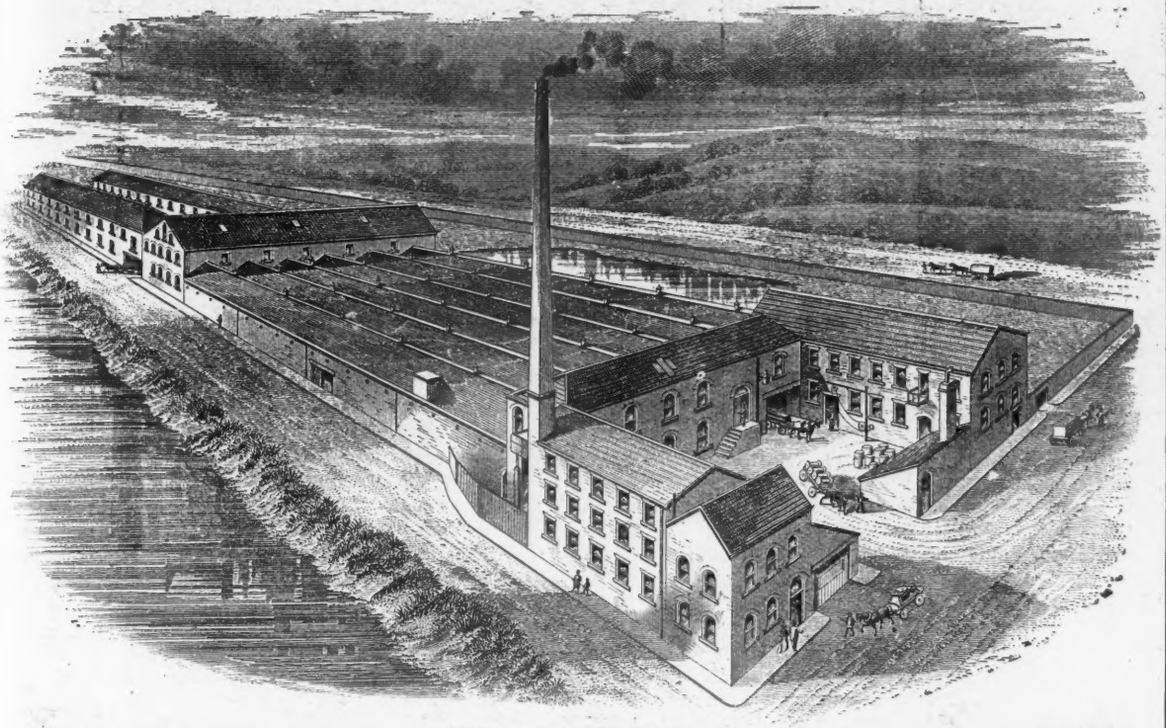

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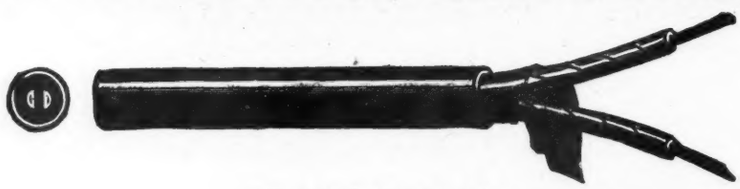

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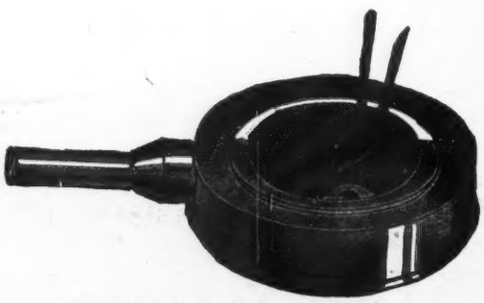

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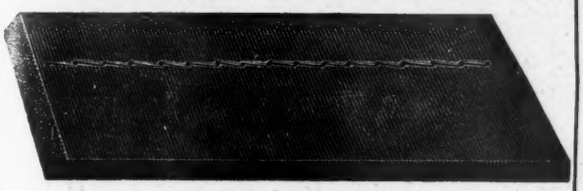

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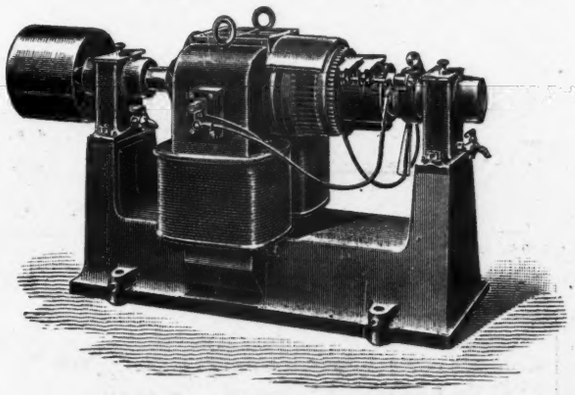

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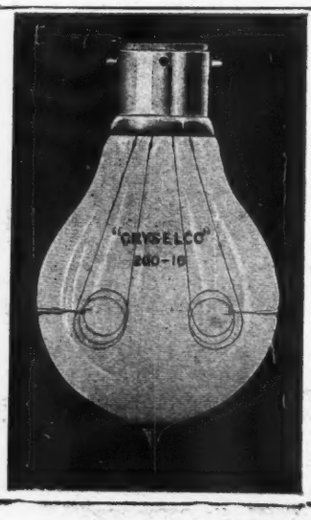

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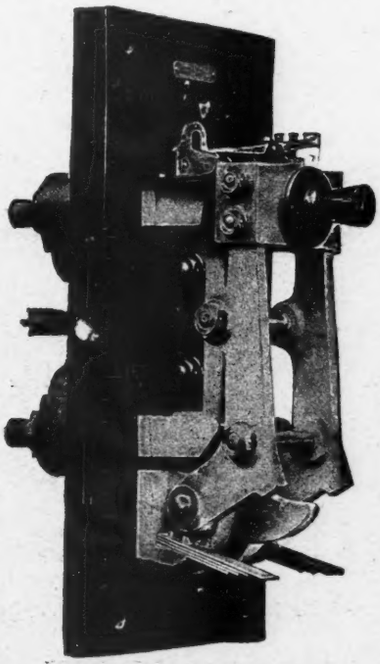

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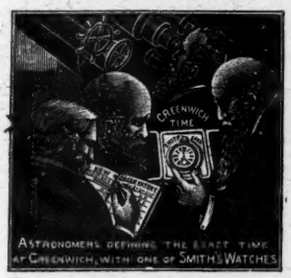

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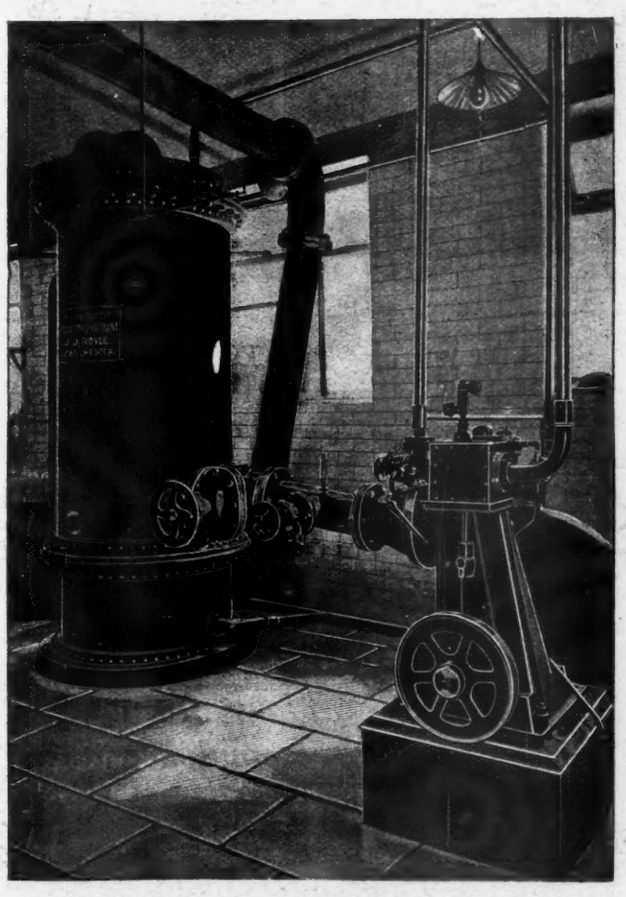

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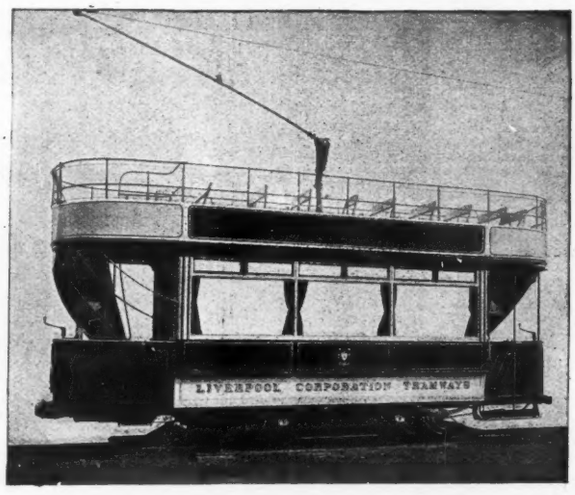

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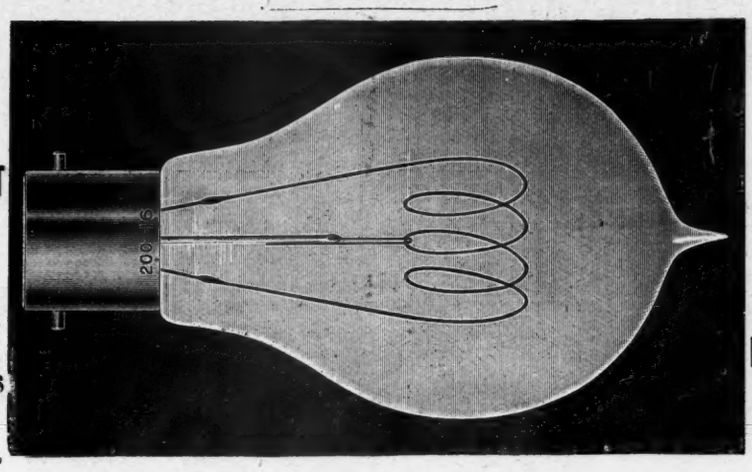

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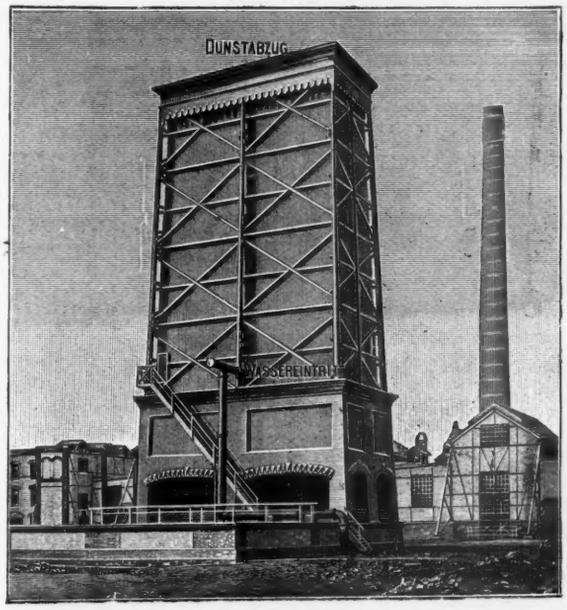

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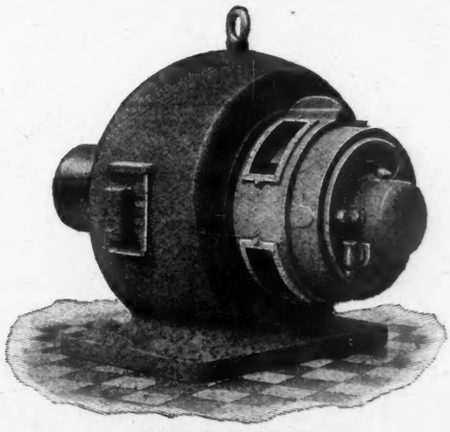

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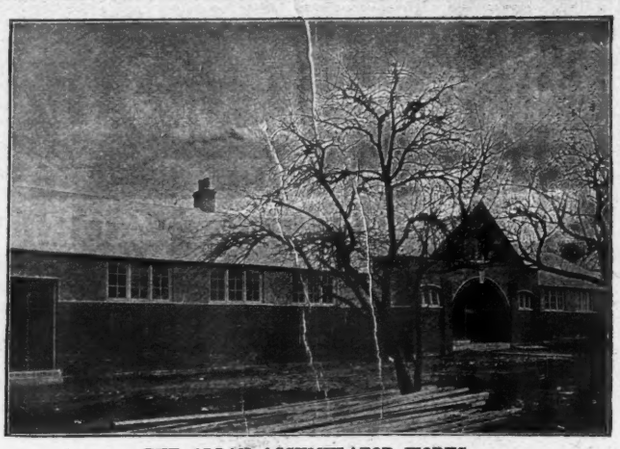

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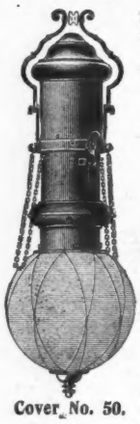

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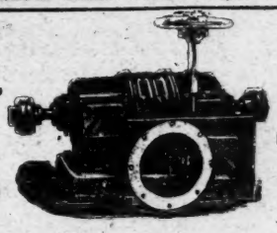

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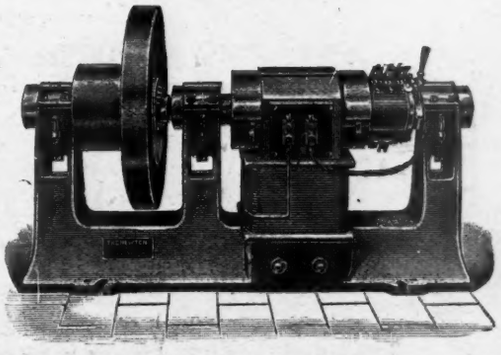

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on receipt of Sample Sets.

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Johnson & Phillips.

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British Westinghouse Electric Co.
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(*Continued on next Page.*)

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Miscellaneous Advertisements *relating to Situations, Articles for Sale and Wanted, &c., &c., appear on* **Sup. 17.**

TRANSFORMERS and ARC LAMPS.

CHINGFORD,
Essex.

GILBERT ARC LAMP CO., Ltd.

50-80 HOUR OPEN TYPE ORDINARY LENGTH LAMP.
Complete with Weatherproof Hood.

50 TO 80 HOUR "OPEN" TYPE ARC LAMPS, TAKING SIX FEET OF CARBON.

COPY OF TESTIMONIAL.

Corporation Electricity Works,
Blackpool, *April 2nd*, 1900.

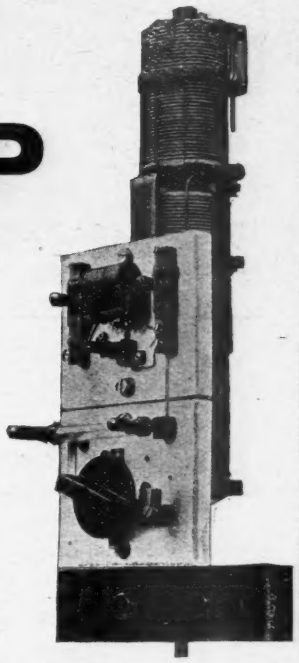
Messrs. THE GILBERT ARC LAMP CO., Ltd.,
Chingford, Essex.

Dear Sirs,—It gives me very great pleasure to say that the 120 Arc Lamps supplied by you have been working for the last 18 months quite satisfactorily; in fact, in my opinion, they are unequalled for rectified currents.

These lamps are of the long-burning open type for rectified currents, and are fixed principally along the promenade on the traction posts.

Neither the heavy gales experienced at Blackpool, nor the vibration due to the trolley system, appears to affect them. These lamps are arranged for burning at any current between 12 and 6 amperes, and to meet this we are using 13 and 9 mm. carbons (instead of 18 and 12 mm.). There are two pairs of carbons, each carbon being 18 inches long. The hours of burning under these conditions are about 45 (at 10 amperes).

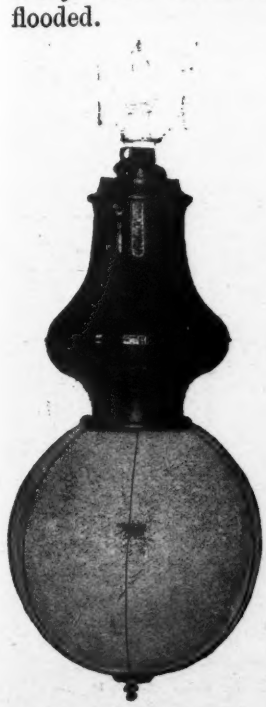
Yours faithfully,
(Signed) R. C. QUIN,
Borough Electrical and Tramway Engineer.



Standard Post Gear 500-V. Switch and Fuse, Massive Terminals, Automatic Cut-out, Disconnecting Switches, Line Resistance, Compensating Resistance, all mounted on Porcelain attached to post by two bolts.

WE have in most cases novel and simple arrangements, not only in our Lamps, but in our Apparatus, and can therefore supply at ***low prices;*** although we trust, in many cases, our things are better, and our Lamps more expensive where expense is worth having, than those of other makers.

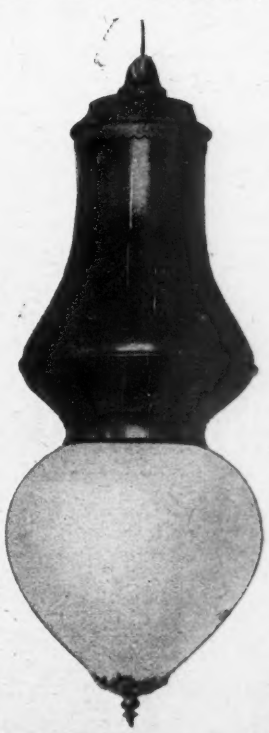
Up to the present we have been principally engaged in carrying out street lighting contracts for Corporations, &c. We are, however, prepared to supply the ***Trade generally*** with ***equally good*** lamps for ordinary work at ***Most Moderate Prices,*** which are really worth considering before buying any of the cheap lamps with which the market is flooded.



REGISTERED DESIGN

NOTICE.

We have a few of our last year's type of Lamp left, a very good Lamp in every respect, which we will sell cheaply to clear them, comprising Alternating and Continuous 12-in. and 9-in. Carbon Lamps and some Enclosed Arc Lamps, with covers, as shown.



THE TRADE MOST LIBERALLY PROTECTED.

C

FARADAY & SON'S

Electric Light Fittings

IN PICTURESQUE & CLASSIC FORMS

Showrooms & Works (Extended)

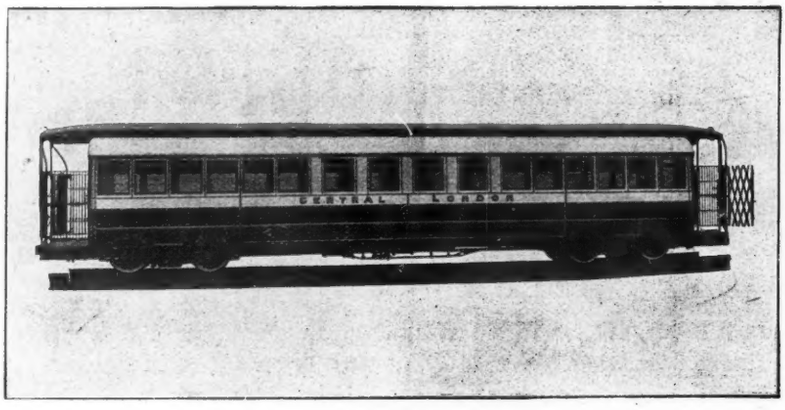
2, 3 & 4, BERNERS ST., OXFORD CIRCUS, W.

ELECTRICAL INTERLOCKING. GOLD MEDAL, CRYSTAL PALACE, 1892.

The Board of Trade have again and again urged the necessity of combining the "Lock" and "Block" systems by actual connection between the Telegraph Instruments and Locking Levers, to effect "inter-dependent working." This great improvement, together with Supplementary Automatic Train Action, has been reliably accomplished and brought into practical use on several lines by Messrs. SAXBY & FARMER, under protection of various Patents granted or assigned to them. *Diploma of Honour (the Highest Award), Edinburgh, 1890.* For Particulars, Plans, and Estimates, apply to

SAXBY & FARMER, Ltd., Railway Signal Contractors, Canterbury Road, KILBURN, LONDON, N.W.

Manufacturers of Railway Signals, Cabins, Interlocking Levers, Block Instruments, and Signal Work of every description, Electrical and Mechanical. 1117



Electric Railway Cars.

Manufactured by
THE BRUSH ELECTRICAL
ENGINEERING COMPANY, Ltd.,
49, Queen Victoria Street, London, E.C.

IMPORTANT IMPROVEMENTS IN GUN METAL SCREW DOWN VALVES.

HOPKINSON'S PATENT "R.I.S." VALVE.

J. HOPKINSON & CO., LTD.

BRITANNIA WORKS HUDDERSFIELD.

LONDON OFFICE AND DEPÔT: 188, QUEEN VICTORIA STREET, E.C.

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THE

ELECTRICAL POWER STORAGE

Co., Ltd.

By Special Appointment

To Her Majesty The Queen.

GOLD MEDAL

Paris, 1900.

HIGHEST AWARD

FOR

STORAGE BATTERIES.

E.P.S.

BATTERIES

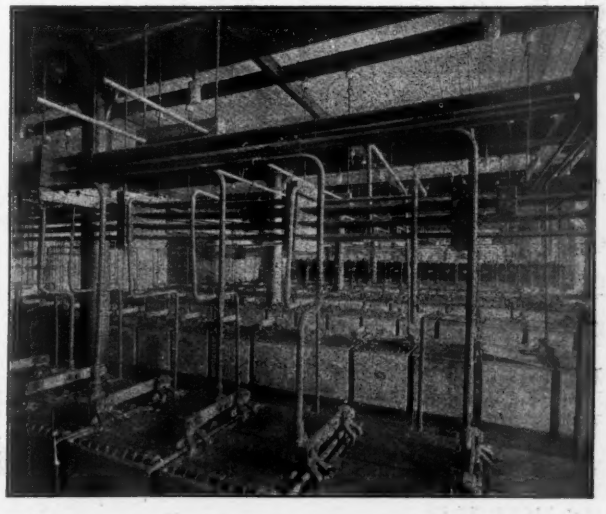
SUPPLIED TO

Belfast Corporation,

TOTAL CAPACITY,

1,100,000

WATT HOURS.



Battery of $K^{WS.}$ Cells at East Bridge St. Station.

THE

ELECTRICAL POWER STORAGE CO., Ltd.,

4, GREAT WINCHESTER STREET, LONDON, E.C.

Works :—MILLWALL, E.

EVERY CONTRACTOR SHOULD USE:—

JOHNSON & PHILLIPS CABLES

TESTED. GUARANTEED.

Telegrams:
"CABLES, OLD CHARLTON."

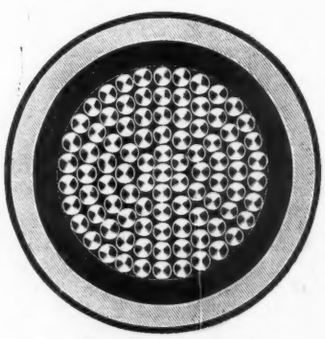
Telephone:
46, WOOLWICH.

HIGHEST DISCOUNT TO THE TRADE. PRICE LIST AND SAMPLES ON APPLICATION.

LEAD-COVERED MAINS.

AS SUPPLIED TO:—

CHATHAM,
BRISTOL,
FLEETWOOD,
MANCHESTER,
NUNEATON,
NEW BROMPTON,
ROCHESTER,
WORCESTER.



FULL SIZE SECTION.

CONDUCTOR.—ONE SQUARE INCH 91/118 RESISTANCE 0·0246 OHMS PER 1000 YARDS.

DIELECTRIC.—"LONG FIBRE" MANILLA PAPER, IMPREGNATED UNDER VACUUM WITH BROOK'S HIGHLY INSULATING COMPOUND.

PROTECTION.—SOLID TUBE, BEST ENGLISH LEAD PUT ON COLD UNDER HYDRAULIC PRESSURE.

TEST.—10,000 VOLTS UNDER WATER.

JOHNSON & PHILLIPS ELECTRIC CABLE WORKS,

Head Office & Factory: OLD CHARLTON, KENT.

ALSO AT MANCHESTER AND GLASGOW.

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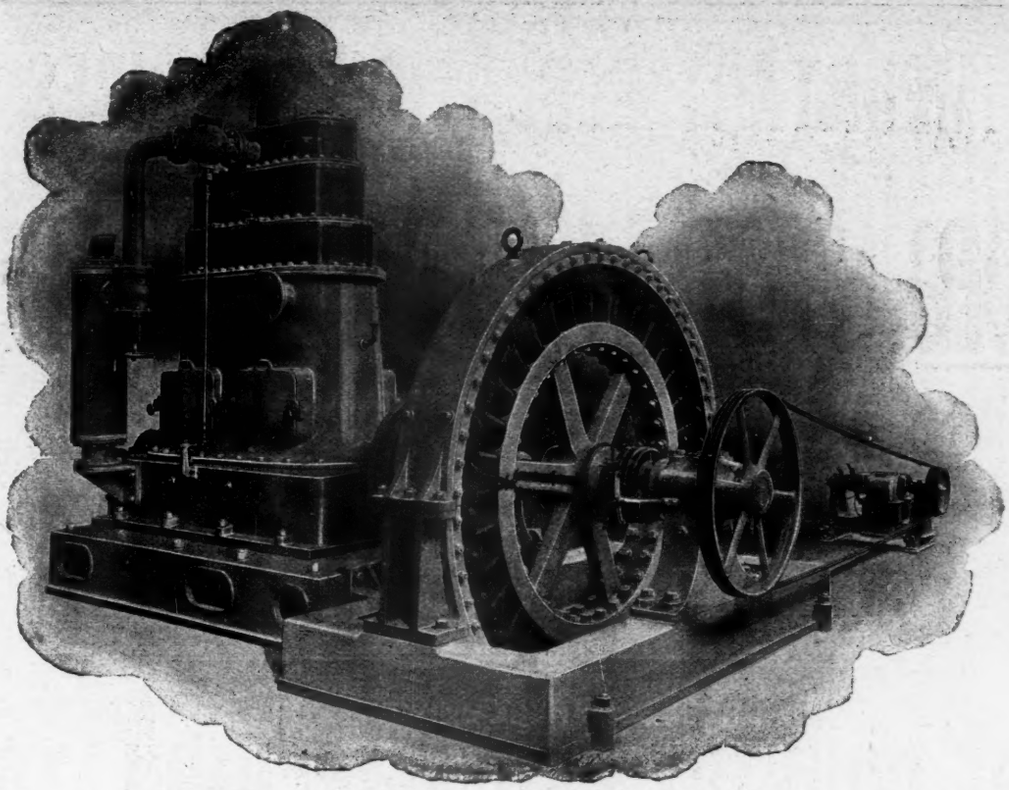


250 I.H.P. Tandem Compound High Speed Engine, Driving Alternating Current Generator.

HIGH SPEED ENGINES

FOR DRIVING DYNAMOS FOR

ELECTRIC LIGHTING AND POWER,

ECONOMICAL, DURABLE, and SILENT,

WITH

FREEDOM FROM VIBRATION, PERFECT GOVERNING AND AUTOMATIC LUBRICATION.

These are made 2-Crank or 3-Crank, Simple, Compound, or Triple Expansion. Standard Sizes to 750 H.P.

ALLEY & MACLELLAN,

Sentinel Engine Works,

POLMADIE, GLASGOW.

Telegrams: "ALLEY, GLASGOW."
Telephone Nos. 673, and 4446.

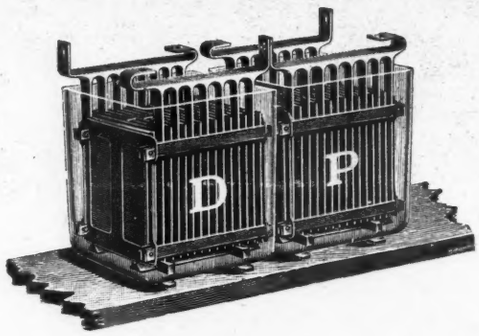
LANDIS

ALSO AT MANCHESTER AND GLASGOW.

IMPORTANT REDUCTION IN PRICES

OF

D.P. STORAGE BATTERIES.



THE COUNTRY HOUSE ACCUMULATOR

The Directors have pleasure in announcing that, owing to the introduction of labour-saving machines in the various departments, with a corresponding increase of production and the use of water-power for formation, they are able to offer a substantial reduction in prices.

A New Catalogue is being prepared and will be ready shortly, but in the meantime intending purchasers of Storage Batteries are advised to write for Special Quotations.

We can deliver Lighting Sets of D.P. Storage Batteries in from Two to Six Days, according to size, from receipt of order.

In comparing Prices please note these Cells do not, as in the case of many others, require to be formed at the User's Expense. All Plates are sent out from the Works fully formed, and can be ready for use within 15 hours from the time the Charging commences.

The D.P. BATTERY CO., Ltd.,

HEAD OFFICES (to which all communications should be sent):

66, Victoria Street, Westminster, London, S.W.

Telegrams :—"ACCUMULATOR, LONDON." Telephones :—71 and 393, WESTMINSTER.

WORKS:—

Lumford Mills, Bakewell, Derbyshire; and Victoria Works, Charlton, Kent.

MONOBLOC

JANDUS
ENCLOSED ARC LAMP PATENTS.

It is claimed that the Master Patents held by the Jandus Arc Lamp and Electric Company control the arrangements which are essential in every successful Enclosed Arc Lamp.

IMPORTANT ANNOUNCEMENT.

The List of Licensees has now been closed, and it is not the intention of the Jandus Company to issue any more Licenses. A complete list of the Licensees is given below, and the public are warned against purchasing from other sources Enclosed Arc Lamps which infringe the Jandus Company's Patents :—

Messrs. CROMPTON & CO., Mansion House Buildings, E.C. (Future royalties commuted at £500).

Messrs. DRAKE & GORHAM, 66, Victoria Street, Westminster, S.W.

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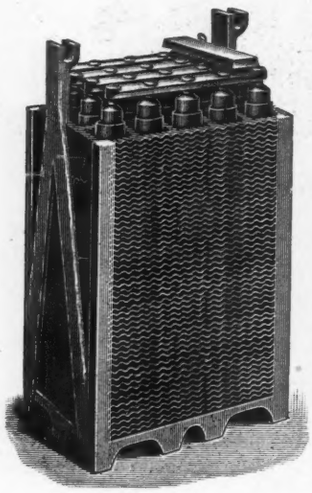

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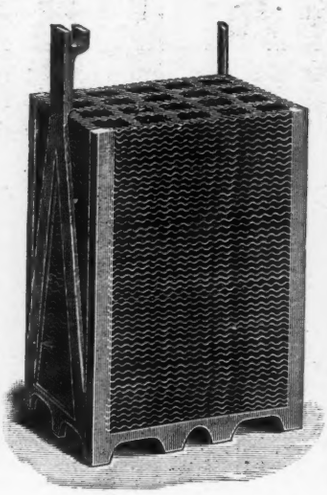

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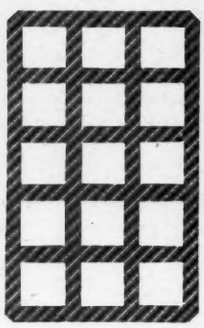

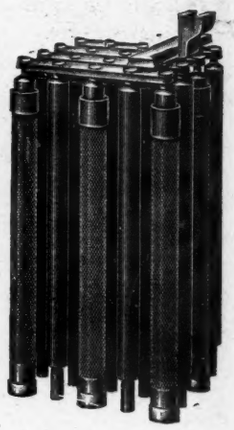

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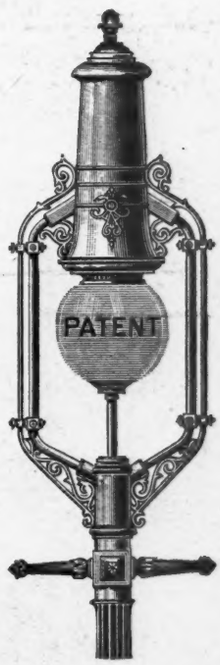

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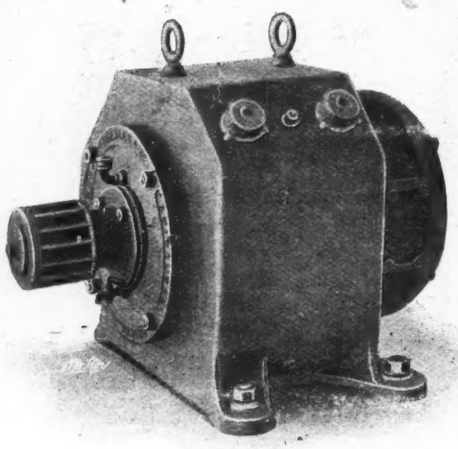

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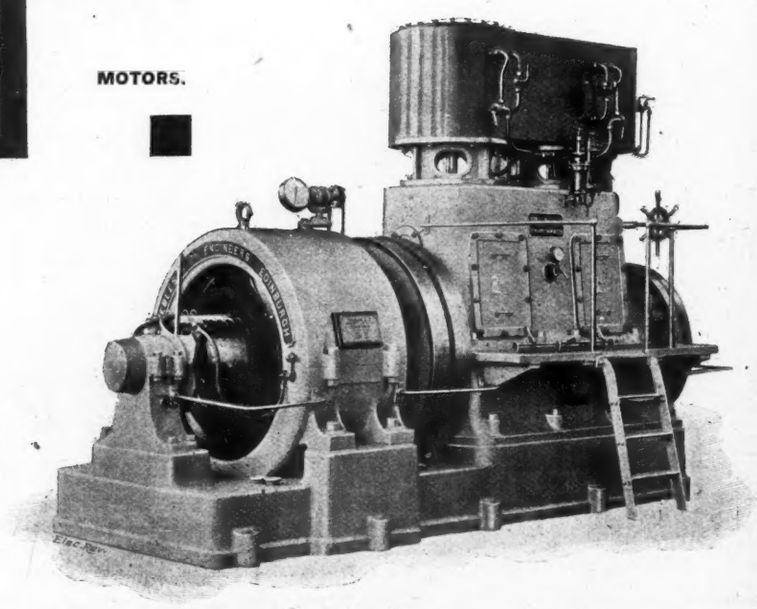

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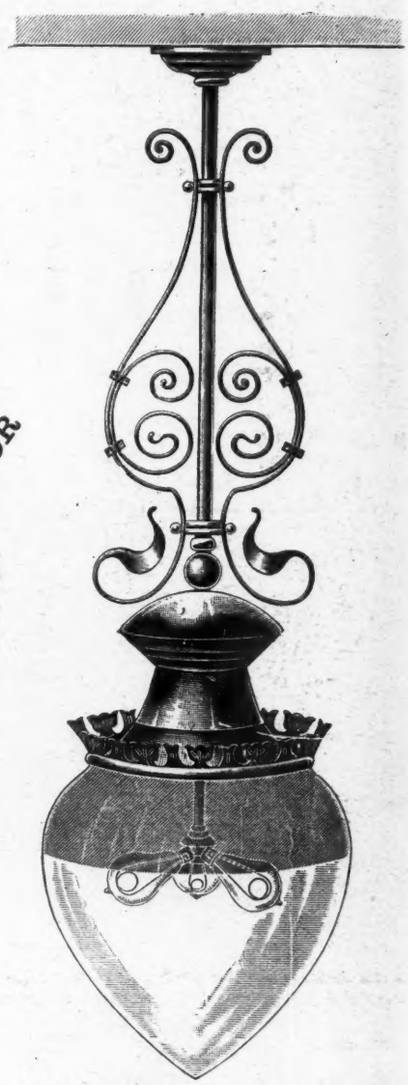

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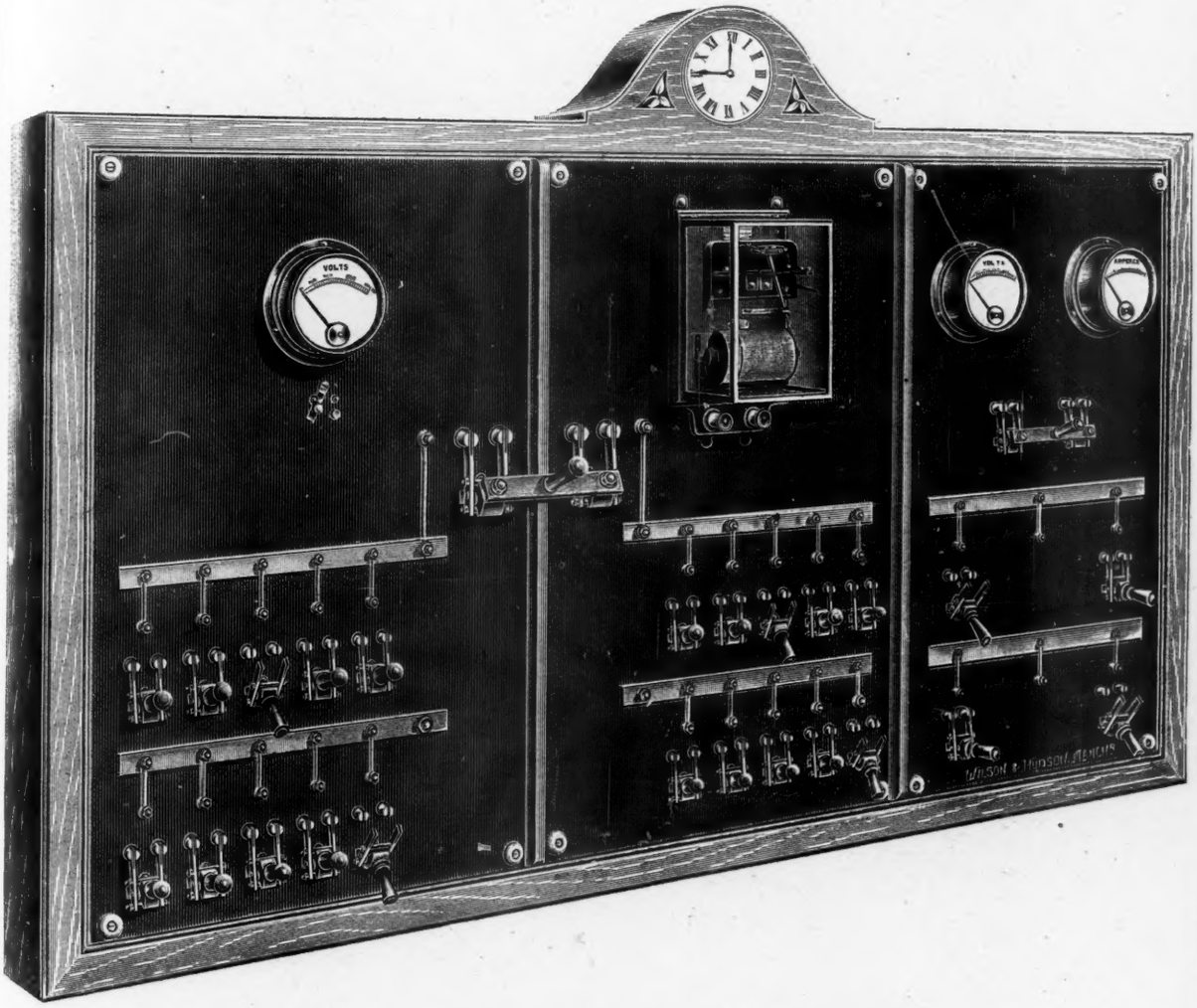

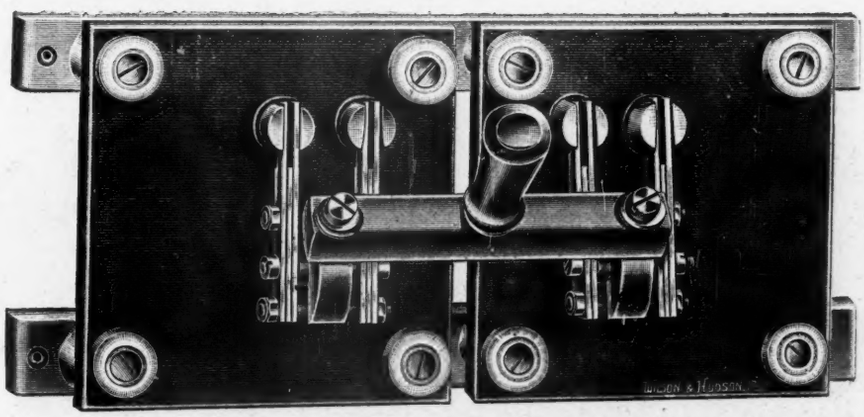

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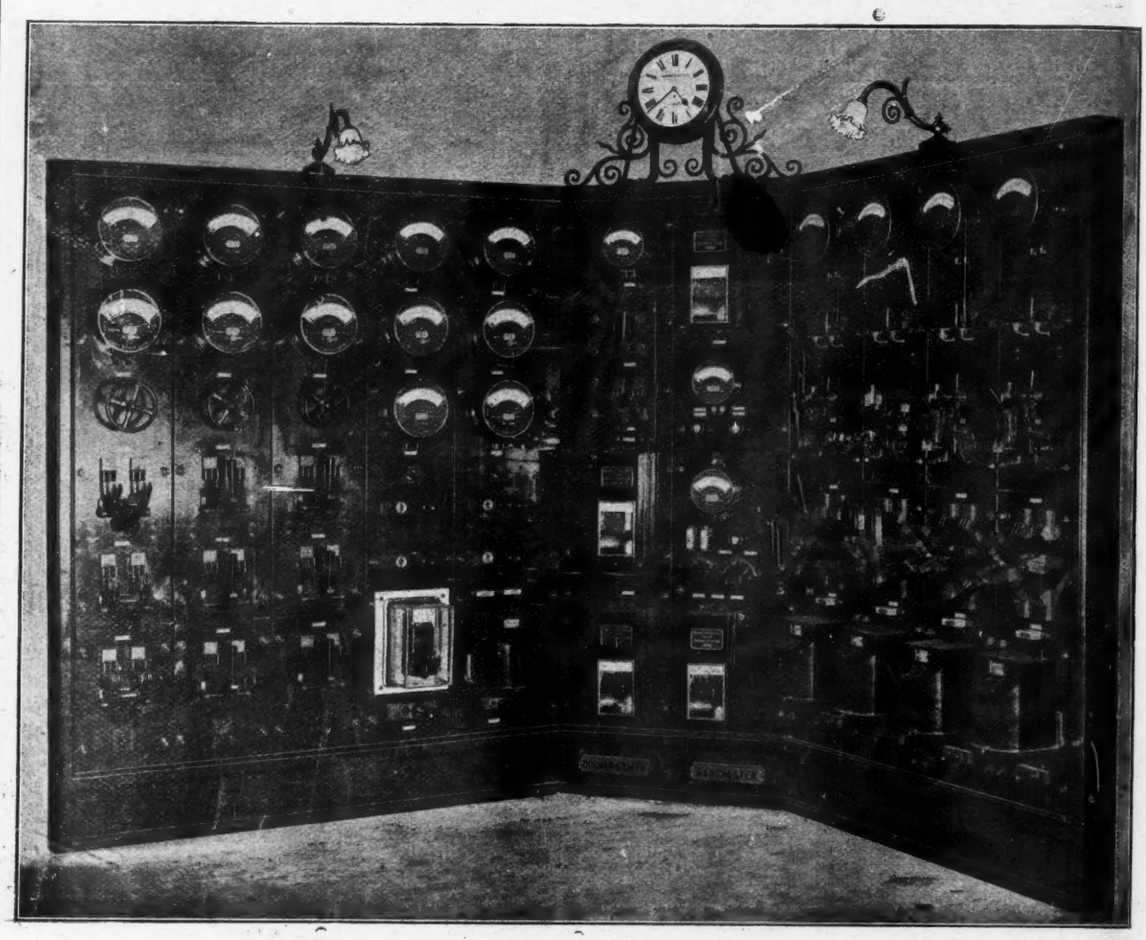

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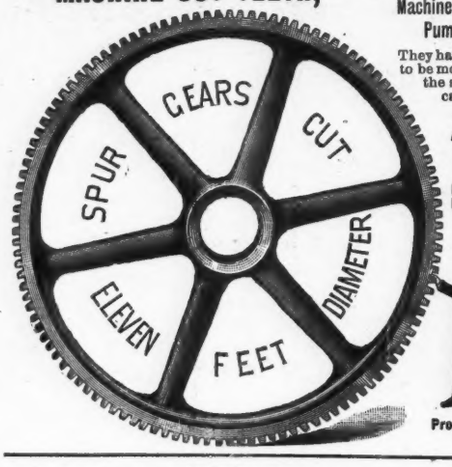

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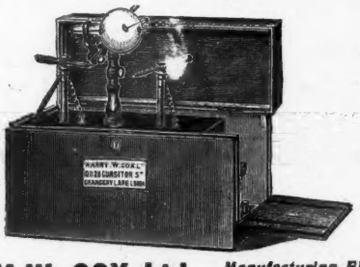

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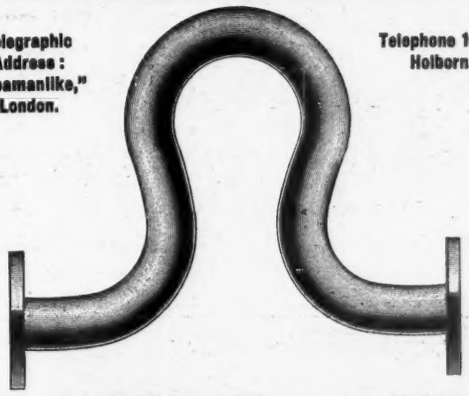

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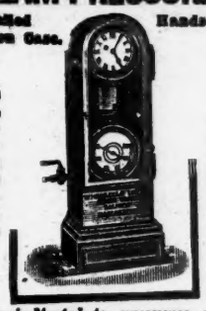

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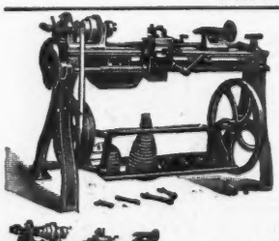

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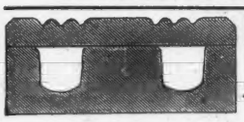

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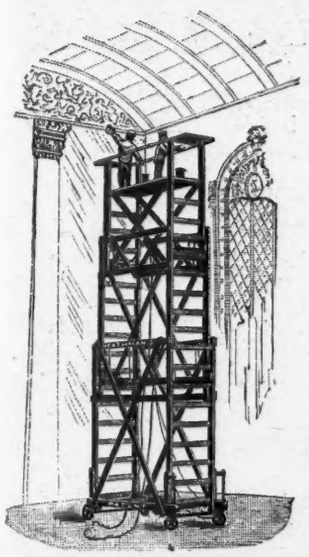

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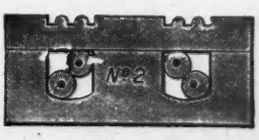

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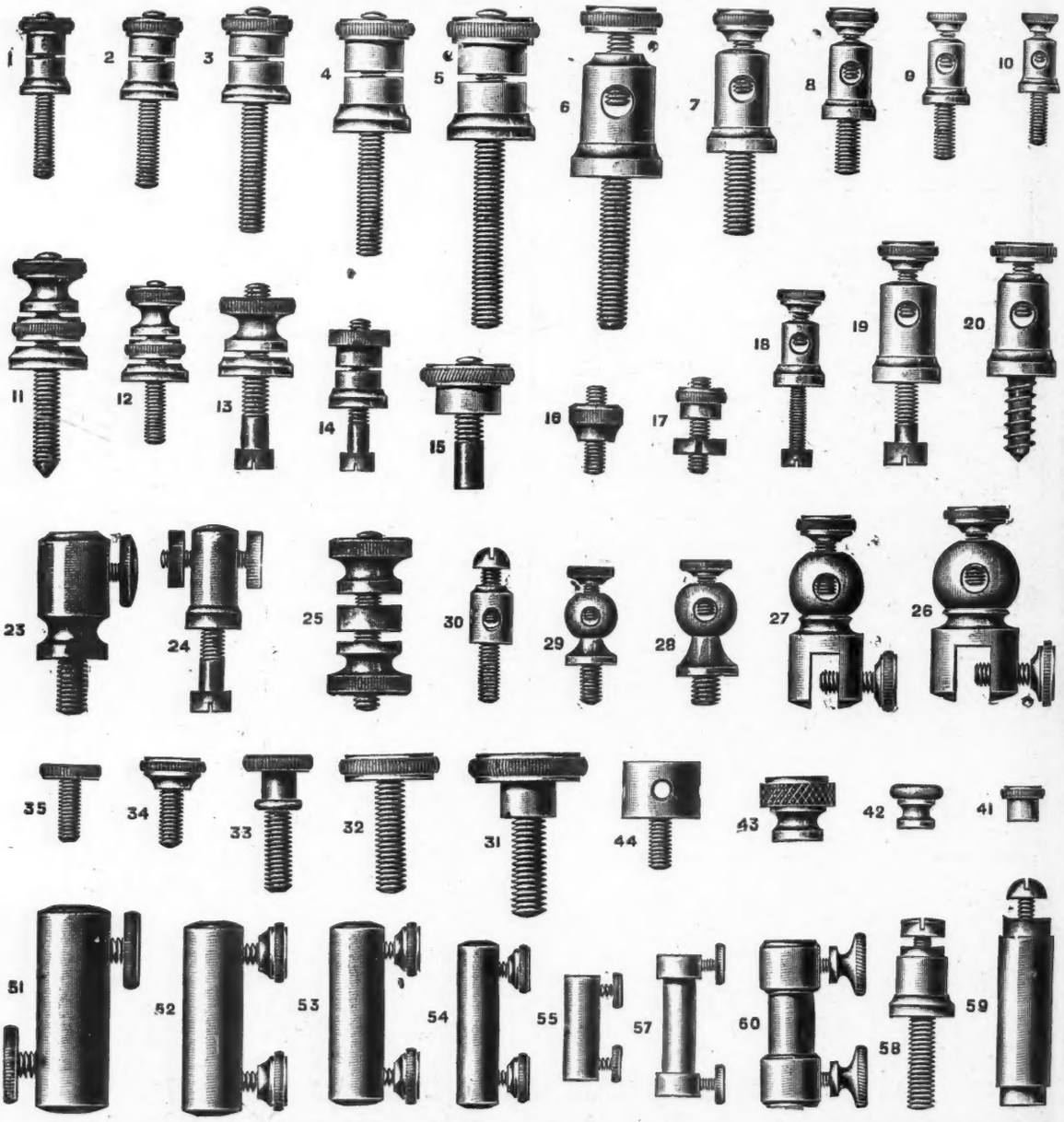

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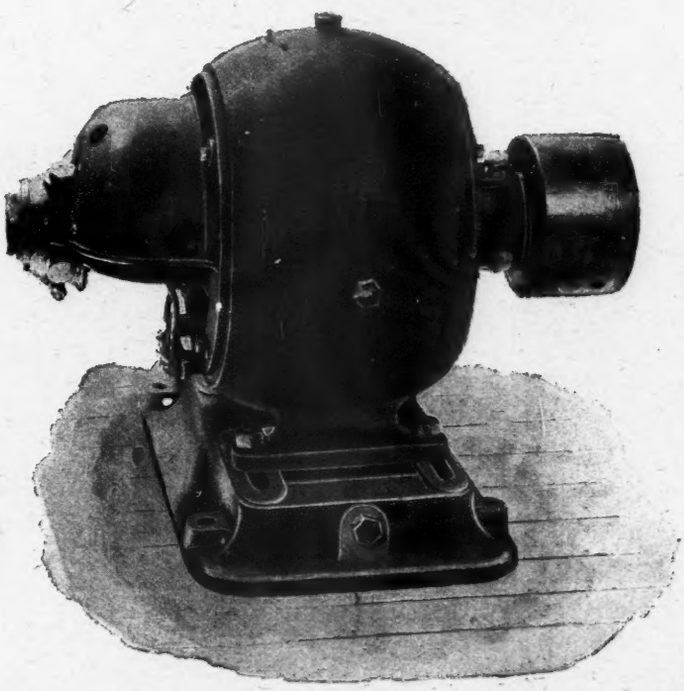

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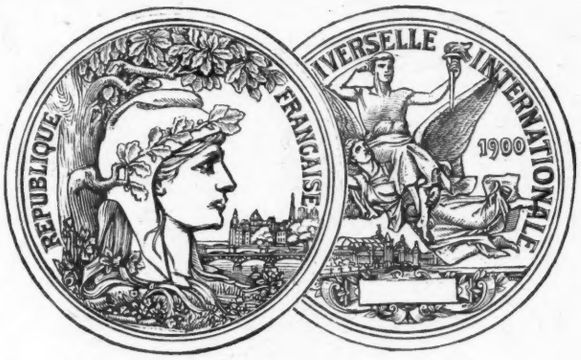

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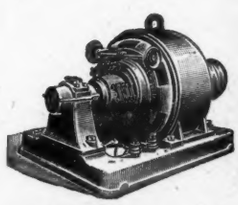

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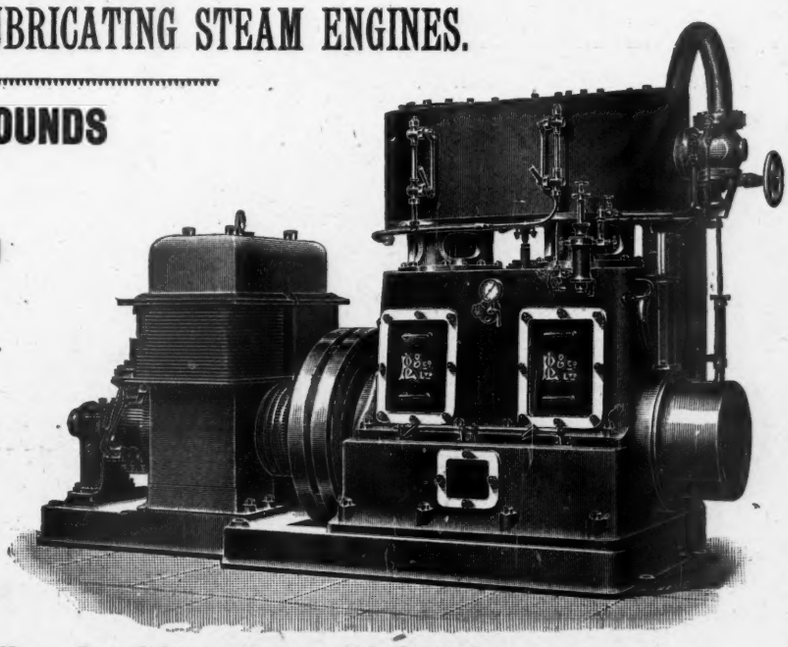

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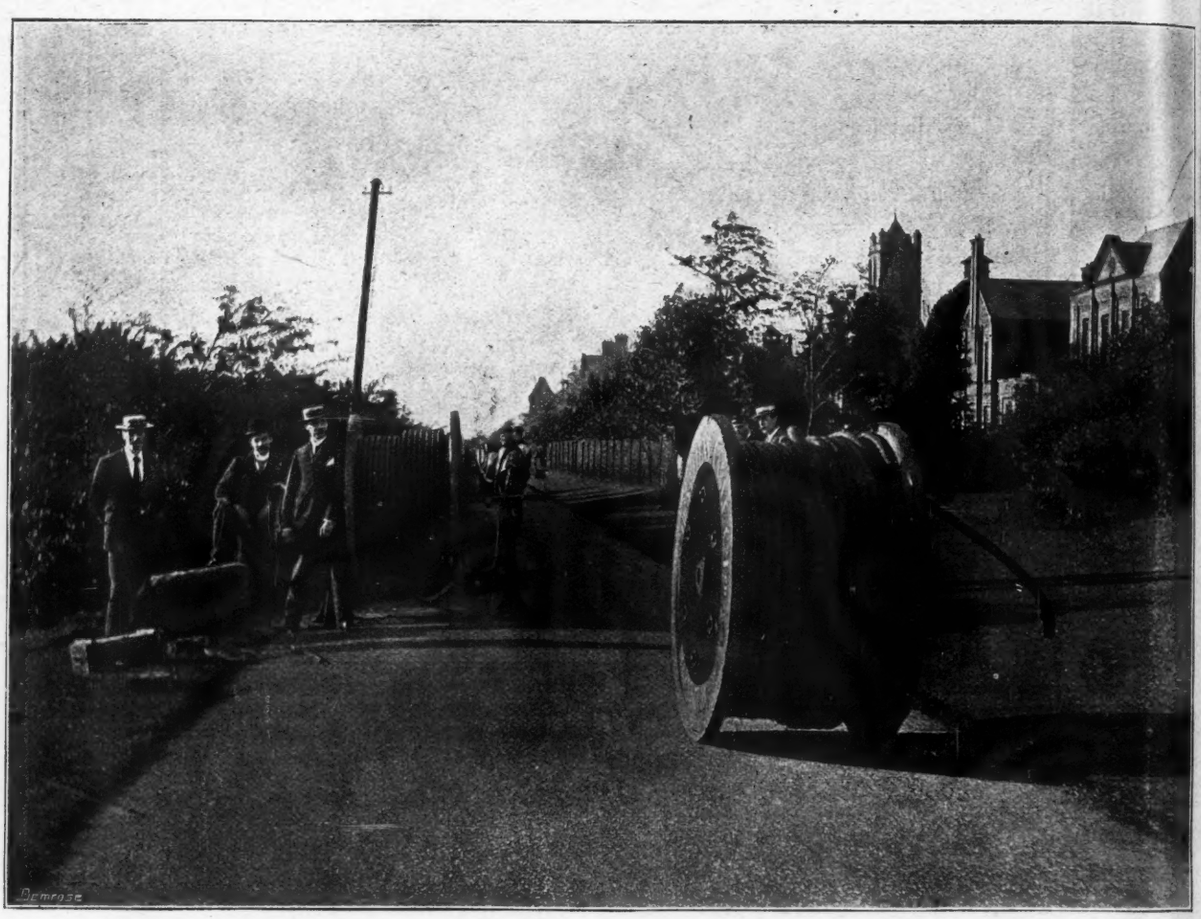

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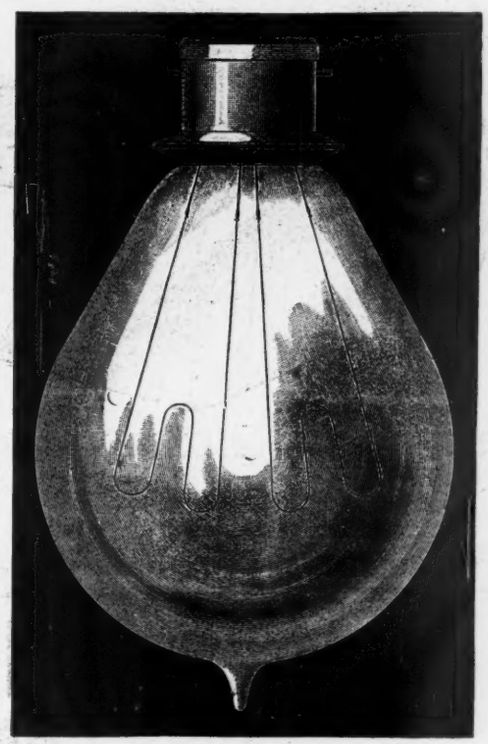

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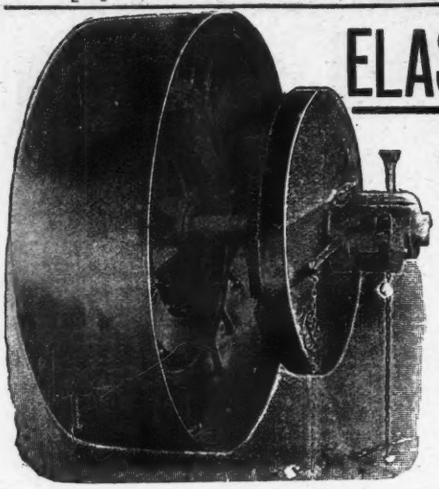

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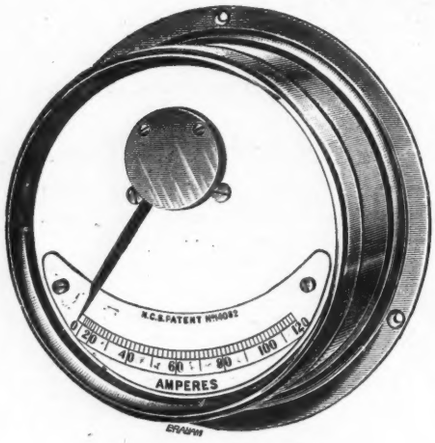

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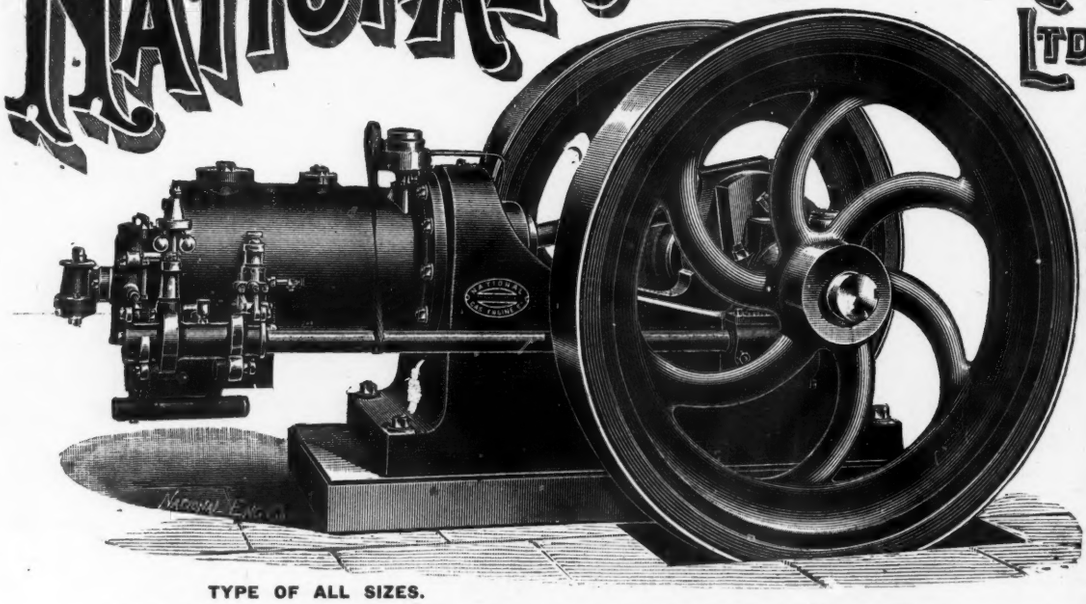

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Telephone Apparatus—Pinkston Power Station.

THE CORPORATION OF GLASGOW are prepared to receive Tenders for the supply of Telephone Apparatus in connection with the Glasgow Corporation Tramways.

Specification, with Form of Tender, &c., can be obtained on application to Mr. John Young, General Manager, 88, Renfield Street, Glasgow. A bank draft for 2 guineas, payable to the General Manager, must be sent with each application for Specification. Deposits will be returned only on receipt of a *bonâ fide* tender.

Sealed Tenders, marked "Tramways—Tender for Telephone Apparatus," must be lodged with the subscriber, not later than 9 a.m. on FRIDAY, JANUARY 18th, 1901.

The Corporation do not bind themselves to accept the lowest or any tender.

J. D. MARWICK,
Town Clerk.

City Chambers, Glasgow,
December 22nd, 1900. 934

METROPOLITAN BOROUGH OF POPLAR.

NOTICE IS HEREBY GIVEN that the Council of the above-named Borough is prepared to receive tenders for the SUPPLY OF AN ELECTRIC CRANE to lift a maximum load of 5 tons, with a return block, the electricity supply being continuous current at 460 volts.

A copy of the specification and form of tender, together with all further information, may, upon payment of £1 1s., be obtained from the Borough Electrical Engineer, at the Electricity Works, Glaucus Street, Bromley-by-Bow, E. The amount of the deposit will only be returned after a *bonâ fide* tender has been received and opened by the Council.

The Council does not bind itself to accept the lowest or any tender.

Tenders, endorsed "Tender for Electric Crane," to be delivered to the undersigned on or before the 16th day of January next.

LEONARD POTTS,
Acting Town Clerk.

Council Offices,
117, High Street, Poplar, E.
December 19th, 1900. 935

Official Notices.

BOROUGH OF ROTHERHAM.

TENDERS are invited for the supply of Electricity Meters of sizes for maximum currents of 5, 10, 20, 25, and 35 amperes. The supply pressure is 230 volts, continuous current.

The Contractors must not pay less than the standard rate of wages paid in the district, and must observe the proper conditions of labour, and no sub-contracting will be allowed except by permission of the Corporation.

Tenders, endorsed "Electricity Meters," should be sent to me not later than SATURDAY, the 19th day of January, 1901.

The Corporation do not bind themselves to accept the lowest or any Tender.

By order,
H. HAMPTON COPNALL,
Town Clerk.

Council Hall, Rotherham,
December 20th, 1900. 904

SOUTHAMPTON CORPORATION TRAMWAYS.

Contract No. 9.

OVERHEAD ELECTRICAL EQUIPMENT OF LINES.

THE CORPORATION invite tenders for the Overhead Electrical Equipment of about 1¾ miles of tramway route, forming an extension to the existing tramways.

Specification and form of tender may be obtained at the Borough Engineer's Office at Southampton, on payment of a fee of three guineas, which will be returned on receipt of a *bona fide* tender; and copies of the plans and specification may be inspected, but not obtained, at the offices of the Consulting Engineers, Messrs. KINCAID, WALLER & MANVILLE, 29, Great George Street, Westminster, on and after the 28th December, 1900.

The Contractor will be required to pay not less than the minimum standard rate of wages for the time being in each branch of the trade at the date of the contract.

The Corporation do not bind themselves to accept the lowest or any tender, and the contractor whose tender is accepted shall enter into a formal agreement under seal with sufficient sureties for the due performance of his contract. Sealed tenders endorsed "Corporation Tramways, Tender for Contract No. 9," must be forwarded to me before noon on the 7th day of January, 1901.

R. R. LINTHORNE,
Town Clerk.

Municipal Offices,
Southampton.
December 1900. 913

CITY OF COPENHAGEN.

ACCUMULATORS.

THE CORPORATION OF COPENHAGEN require tenders for the delivery of two accumulator batteries for lighting and traction purposes, to a new central station. Each battery about 500 kilowatt.

Specification and conditions of contract may be had on application to Elektrisk Station, Copenhagen, K, on payment of £1, which sum will be refunded on return of the specification accompanied with the tender.

Tenders must be sent to Kjóbenhavns Belysningsvæsen, Vestre Boulevard, Copenhagen B, not later than 12 o'clock noon, January the 21st, 1901.

Kjóbenhavns Belysningsvæsen,
December, 1900. 954

[*Continued on next page.*]

Official Notices.—*Continued.*

TO

MESSRS. W. T. GLOVER & CO., LTD.,

Trafford Park and Westminster.

GENTLEMEN—

We beg to apologise to you for having repeatedly, through the gross carelessness of a member of our staff, sold cable as of your manufacture which was not in fact made by you, and in consideration of your granting a stay of proceedings, in the action commenced by you against us, we agree to pay your costs as between Solicitor and Client, including the cost of the publication of this letter, to which publication we assent.

(Signed)
SAX SLATTER & CO., LTD.,

Date, *December 1st*, 1900. 910

COUNTY BOROUGH OF SUNDERLAND

HYLTON ROAD ELECTRIC LIGHTING STATION.

THE CORPORATION OF SUNDERLAND are prepared to receive tenders for the supply of

(A.) Condensing Plant and Cooling Tower.
(B.) Secondary Battery.
(C.) Mains, Switchboard.
(D.) Travelling Crane.

The specification and form of tender can be obtained on application to the Borough Electrical Engineer, Mr. J. F. C. SNELL, Assoc.M.Inst.C.E., at his office, Dunning Street, Sunderland, and on payment of a deposit of One Guinea, which will be returned on receipt of a *bona fide* tender.

Sealed tenders, addressed to the "Chairman of the Lighting Committee," Town Hall, Sunderland, must be delivered at my office not later than 12 o'clock noon, on Friday the 1st day of February, 1901. Tenders to be endorsed as worded above, according as they relate to the particular sections specified.

The Corporation do not bind themselves to accept the lowest or any tender.

By order,
FRAS. M. BOWEY,
Town Clerk.

Town Hall, Sunderland,
December 17th, 1900. 911

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REFERENCE BOOK OF

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FOR

ELECTRIC STREET RAILWAY ENGINEERS.

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Author of Electric Lighting Specifications for the Use of Engineers and Architects.

In the pages of this book are collected the principal tables and formulæ of which the electric street railway engineer makes use in his practical everyday work, arranged in the most convenient manner for practical use.

Only those tables and formulæ in daily use, and which are for the most part complete in themselves, have been inserted. A logical order has been followed in the arrangement, beginning with the steam plant and passing successively through cars and their equipment, overhead work, track work, and miscellaneous tables and formulæ in constant use. A number of the tables and formulæ are original while many others have been modified and extended to adapt them to the conditions imposed in electric street railway work.

London: H. ALABASTER, GATEHOUSE & CO.,
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MAKERS OF ALL KINDS OF
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See Advertisement December 21st. 8774

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ELECTRICAL ENGINEERS AND CONTRACTORS
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POPULARLY EXPLAINED,

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This work, which is beautifully illustrated, is designed to give in popular language an account of the progress of Electric Traction. The chief methods of employing electricity for traction purposes are explained, while the most noteworthy foreign and Continental systems are described and illustrated.

It will be of great use to Members of Municipal Authorities and Tramway Companies who are considering the question of adopting Electric Traction.

It is interesting to the general public, because English systems are for the first time popularly explained.

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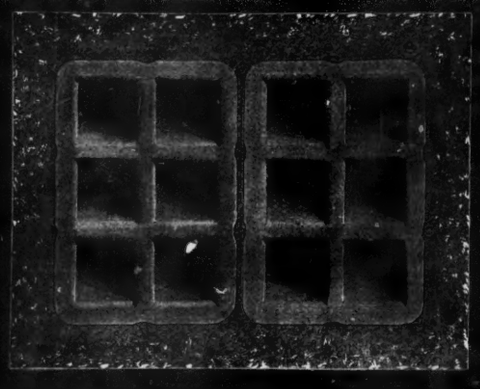

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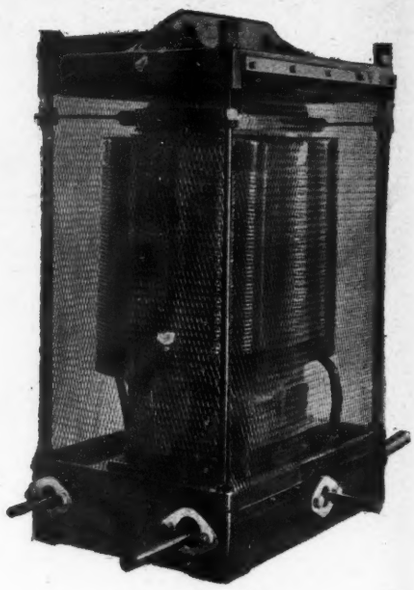

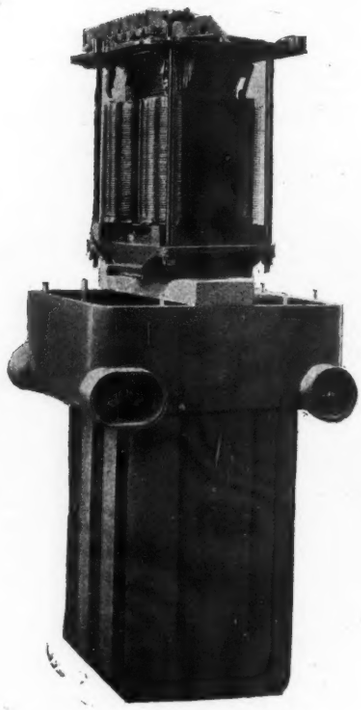

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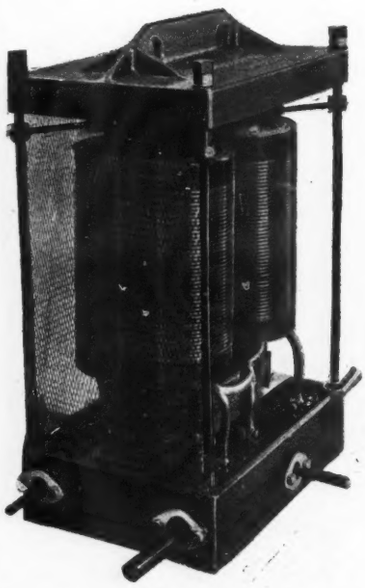

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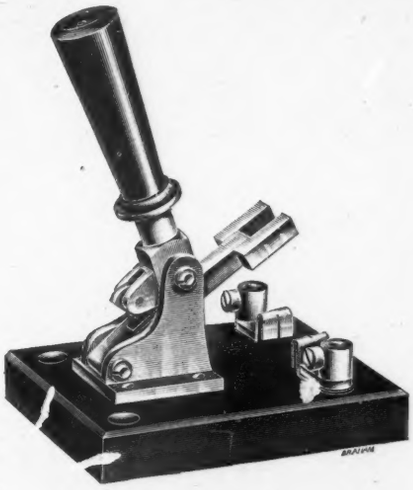

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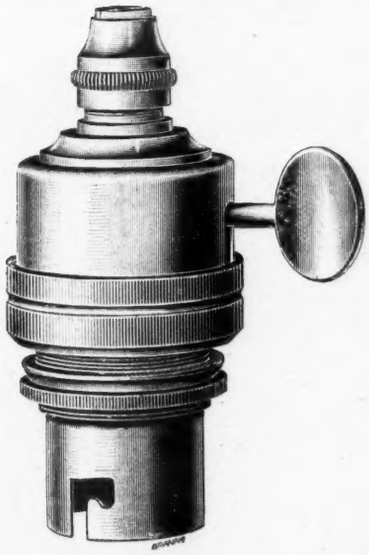

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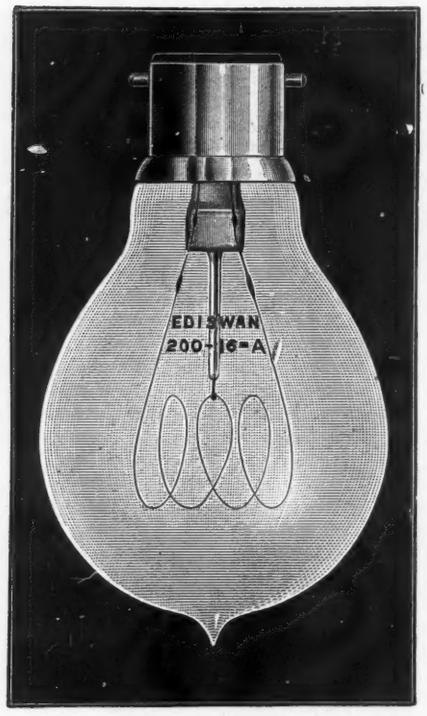

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The Company make a Speciality of Fittings for Public Buildings, Churches, Mansions, Hotels and Theatres, and have a large staff of Artist Designers (at the disposal of the Trade) to prepare designs to correspond with special architectural features and decorations.

Fig. 3764 Illustrates a recent 3-light design in Oxydised Silver.

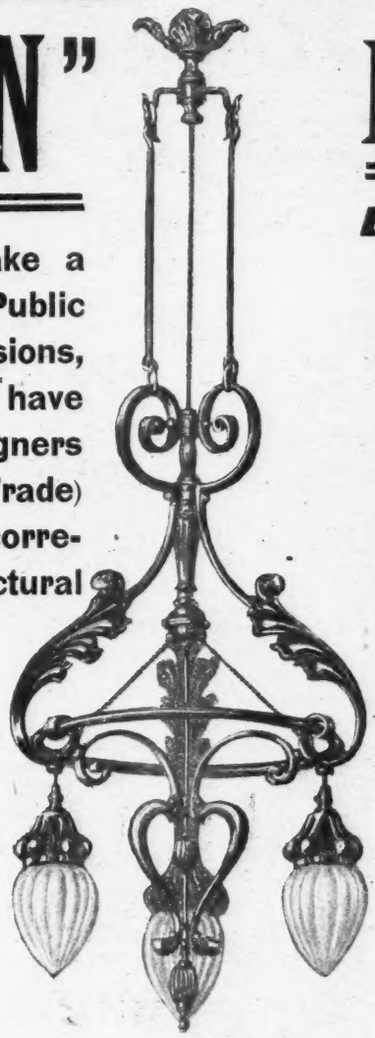

Fig. 3764.

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Fig. 4022.

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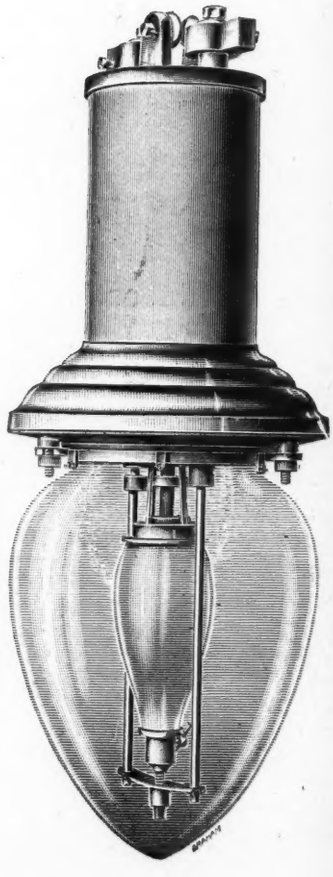

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SITUATIONS VACANT.—*Continued.*

SITUATIONS VACANT.—*Continued.*

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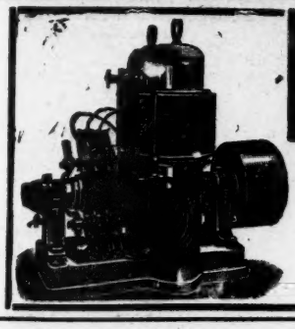

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THE

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***1901* Edition**

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Relating to Situations Vacant, Situations Wanted, Businesses Wanted, Businesses for Sale, Patents for Sale, Specific Articles of any kind Wanted, or for Sale or Exchange, are inserted at the rate of ONE PENNY Per Word (minimum 1s.).

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SITUATIONS VACANT.

If letters are not to be delivered to certain firms or individuals (if known), instructions to that effect should be sent to the Manager of the ELECTRICAL REVIEW, who will do his best to carry out such instructions. Letters of applicants cannot in such cases be returned to them, nor can the names of Advertisers using a number or a *nom de plume* in any way be disclosed.

Original Testimonials should never be sent.

BOROUGH OF HAMPSTEAD.

Assistant Electrical Engineer Wanted.

THE BOROUGH COUNCIL are prepared to appoint an Assistant Electrical Engineer to take charge of the running of their electric light station on one of the shifts, and to carry out the instructions of their Chief Engineer.

He must have had practical experience of alternating current station work (preferably with Siemens and Ferranti alternators and high-speed engines), including synchronising, running in parallel, indicating engines, and testing alternators and cables, getting out cost sheets, efficiencies, &c. He will be required to reside in the parish, and must not engage in any other business or employment. Salary to commence at £130 per annum.

Applications, stating age and previous experience, together with copies of not more than three testimonials of recent date, to be sent in to me not later than 12 noon on January 2nd.

By Order,
ARTHUR P. JOHNSON,
Town Clerk.

Town Hall, Hampstead,
December 17th, 1900. 976

WANTED by Large Continental Works, manufacturing Generators, Motors and Electrical Apparatus of every description,

A MANAGER AND ENGINEER

to take charge of business in the U.K. and Colonies. Machinery already well introduced in Great Britain.

Applicants must enjoy good reputation, and have large trade connection, and be able to influence good business. Knowledge of Direct and Alternating Current, as well as Installation Work, indispensable.

All communications will be kept strictly confidential.—Apply, 928, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 928

(Continued on next page.)

SITUATIONS WANTED.—*Continued.*

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SITUATIONS VACANT.—*Continued.*

BOROUGH OF ROTHERHAM.

Appointment of Electrical Engineer.

THE CORPORATION invite applications for the post of Borough Electrical Engineer. The gentleman appointed will have to take entire charge of their Electrical Supply Department and the running of the Central Station. Applicants must be familiar with the working of a three-wire continuous current system of supply.

The salary will be at the rate of £200 per annum.

Applications, stating age and experience, and accompanied by copies of not more than four recent testimonials, must be received at my office, endorsed "Electrical Engineer," not later than noon on MONDAY, JANUARY 14th, 1901.

Canvassing in connection with this appointment is strictly forbidden, and will be held to disqualify.

Particulars of the duties of the post can be obtained on application.

(By order),

H. HAMPTON COPNALL.

Town Clerk's Office,
Rotherham. 905

SIR JOHN CASS'S TECHNICAL INSTITUTE,

Jewry Street, Aldgate, E.C.

THE GOVERNORS of Sir John Cass's Foundation are prepared to receive applications for the appointment of Principal of their new Technical Institute in Jewry Street, Aldgate, which will rank as a London Polytechnic. The Principal will be required to devote his whole time to the work of the institution, his full duties commencing on September 1st, 1901. The stipend will be £500 a year and a special arrangement will be made in order to secure the advice and assistance of the principal elected in the equipment of the Institution during the next few months. Applications must be received on or before the 26th day of January, 1901, on forms which, together with full particulars respecting the duties of the appointment, can be obtained on application to the undersigned.

W. H. DAVISON,
Clerk to Sir John Cass's Foundation.

St. Dunstan's Chambers,
10A, Idol Lane,
Eastcheap, E.C. 915

WEST HAM UNION.

To Engineers, Electricians and others.

THE GUARDIANS are desirous of appointing an Expert to advise on the engineering work in connection with the Infirmary now in course of erection at Forest House, Leytonstone, N.E.

Applicants must state their qualifications and the terms and conditions upon which they will be prepared to act, and will be required to deal with the question of the boilers, engines, machinery, lifts and electric lighting for the Institution.

Applications marked "ENGINEER," must be received not later than WEDNESDAY, the 23rd proximo, at the undermentioned office where further particulars can be obtained.

By order,

FRED. E. HILLEARY,
Clerk.

Clerk's Office,
Union Workhouse,
Leytonstone, N.E.
December 19th, 1900. 917

TO ELECTRICAL ENGINEERS.

THE LONDON COUNTY COUNCIL requires the services of a fully qualified Electrical Engineer who has had experience in the construction of electrical tramways, and who will be directly responsible, under the Council's Chief Engineer, for the work of construction, or reconstruction, for electrical traction of the tramways now belonging to, or hereafter to be acquired or constructed by the Council (other than those otherwise provided for), and for the proper and efficient working of the generating station, plant and electrical equipment of the tramways when constructed or reconstructed; and he will be required to discharge such other duties as may be assigned to him.

The salary attached to the appointment will be £1,000 a year, and the gentleman appointed will be required to give his whole time to the duties of his office, and to conform to the Council's regulations in respect of the Superannuation and Provident Fund, in the benefits of which he will participate.

Forms on which application for the appointment is to be made can be obtained from the Clerk of the Council, Spring Gardens, S.W., and the latest time for receiving applications is 10 o'clock a.m., on Monday, 14th January, 1901.

Personal canvassing of members of the Council is strictly prohibited.

G. L. GOMME,
Clerk of the Council.

County Hall, Spring Gardens, S.W.,
December 28th, 1900. 909

BOROUGH OF COLCHESTER.

WANTED at once, thoroughly competent Jointer; one used to three-core distributors preferred. Wages 35s., progressing. Applications to

ALFRED R. SILLAR,
Borough Electrical Engineer.

Osborne Street,
Colchester. 933

SITUATIONS VACANT.—*Continued.*

THE COUNCIL for the Foreign Community of Shanghai require a Municipal Electrical Engineer. Salary, at present rate of exchange, about £510 per annum, with quarters, coal, gas, and medical attendance.

Age, single man preferred, 28 to 40.

Must pass the ordinary insurance medical examination. The candidate selected must undertake to devote his whole time to the duties. His duties will be carried out under the direction of the Works Committee, and he must be competent to superintend general working, conduct routine correspondence, &c., &c. He must have a thorough knowledge of the management of alternating plant and continuous current, arc lighting, good knowledge of mechanical engineering, be able to prepare estimates for independent installations, and be able and willing to personally supervise the entire working of station and lines. Three years' agreement. First class passage and liberal leave rules.

Further particulars may be obtained from Messrs. JOHN POOK AND Co., 63, Leadenhall Street, London, E.C., to whom all applications for the appointment should be forwarded before Saturday, January 12th, 1901. 914

Where Advertisements are to be answered to a given number, letter, or *nom de plume* at the ELECTRICAL REVIEW Office, applications for names and addresses of the Advertisers will be entirely disregarded.

Cheap Prepaid Advertisements are inserted under this heading at the rate of One Penny Per word (minimum 1s.). Three Consecutive Insertions for the price of two.

ARMATURE Winders wanted; only first-class men need apply; constant work guaranteed to really good men.—Apply D. BRUCE PEEBLES & Co., Tay Works, Bonnington, Edinburgh. 9919

BOOK-KEEPER wanted immediately for a Manchester supply house. Good address essential and knowledge of electrical goods preferable.—Address, stating salary required, to No. 922, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 922

CARPENTER-WIREMEN wanted immediately.—Apply with full particulars, wages, &c., BAUGHAN & Co., Reading. 926

DRAUGHTSMAN wanted for dynamo and alternator detail drawings. Must be quick and accurate.—Address, stating age, wages, and experience to Box 665, at Horncastle's, Cheapside, E.C. 805

ELECTRICIAN wanted, thoroughly capable of designing dynamos and motors, and superintending their manufacture. State age, past experience, and salary required.—Address 858, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 858

IMPROVERS wanted in arc lamp finishing and adjusting, and transformer departments; must be over 21. Must have had experience in some works, as well as a technical training in the day classes of some engineering college. Start at 25s.—GILBERT ARC LAMP COMPANY, LIMITED, Chingford. 840

JUNIOR Clerk required in the office of an electric supply company, should write well and be quick at figures.—Apply by letter, stating salary required, to "MOTOR," c/o Street's Agency, 30, Cornhill, E.C. 978

LAD Wanted, about 17, strong and intelligent, to assist engineer in electric light installation in London. Should have some experience of gas engine and accumulator plant. Permanent berth for steady worker; first-class character and references indispensable.—Apply by letter only, giving age, past work, and copies of testimonials, to COBLE, 30, Kemble Road, Croydon. 906

REQUIRED for electrical works, a competent Man to superintend manufacture of small dynamos, motors, &c,—Apply by letter stating previous engagements and salary required, to "VICTOR," Box 2958, Sell's Offices, Fleet Street, E.C. 903

VACANCY occurs for Pupils in electric lighting station in Midlands. Small premium, no salary.—Write 822, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 922

WANTED.—Jointer for street mains and general wiring. Permanent berth to the right man.—Apply, stating experience and wages required, to "SECRETARY," Guildford Electricity Supply Company, Guildford. 906

WANTED.—Smart Young Fellow as Armature Winder, one thoroughly used to Brush open coil arc light armatures; must be also capable of carrying out own fitting; permanent employment to suitable man.—Give wages and send copies of references to 900, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 900

WANTED.—Smart Youth for works laboratory.—Send full particulars of knowledge, &c., to "P. S.," c/o Street's Agency, 30, Cornhill, E.C. 920

WIREMAN Carpenters wanted at once.—Apply with testimonials.—HILL, UPTON & Co., Oxford. 817

WORKING Foreman required, must be used to piece work and labour saving tools, good mechanical training and one used to electrical work preferred, to take charge of small shop (50 hands) in London district. Starting salary £3.—Apply to 789, c/o The ELECTRICAL REVIEW, 4, Ludgate Hill, London. 789

SITUATIONS WANTED.

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Cheap Prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two.

APPRENTICE.—Wanted to apprentice a young man, aged 20, for three years. Electrical fittings works near Westminster preferred.—Forward copy of terms to 770, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 770

(*Continued on next page.*)

ARTICLES WANTED.—*Continued.*

4, LUDGATE HILL, LONDON.

(Continued on next page.)

SITUATIONS WANTED.—*Continued.*

ELECTRICAL Engineer seeks opening; all round man, steam, gas or oil motors, dynamos, motors accumulators, wiring for lighting or power.—BUSBY, 70, Morley Road, West Ham, E. 874

ELECTRICIAN Engineer (32), charge of plant, repairs.—"B.," 59, Granleigh Road, Leytonstone. 901

GENTLEMAN, 15 years' experience as representative and in office, wants berth with wholesale firm; close buyer.—937, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 937

JOINTER wants permanent situation, used to Callender's, B.I.W., and Henley's cables. Wages £2 a week; can do own wiping.—907, ELECTRICAL REVIEW, 4 Ludgate Hill, London. 907

NOTICE.—To Wiring Contractors. The Simplex Steel Conduit Company, Limited, beg to inform contractors and engineers that they have on their register the names of several wiremen experienced in the erection of the Simplex conduit system, who are now open for engagement. List of names and particulars sent on receipt of application, and employers are invited to make use of the facilities offered. 8619

RESPONSIBLE berth as Assistant Manager or Manager of department in a manufacturing or wholesale electrical accessories business, desired by advertiser with good connection, experience, and references.—Address, 818, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 818

TRAMWAYS.—Engineer requires re-engagement, well up in all construction work. Good draughtsman. First-class references.—786, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 786

WIREMAN-Carpenter, practical, lighting, bells, motor work, &c.—34, Droop Street, W. 939

WIREMAN, casing, Simplex, bells, situation.—"G.," 68, Vine Street Buildings, Tooley Street, S.E. 931

WIREMAN (30), competent in all branches, simplex, casing, or barrel. Town or country. (Late foreman).—777, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 777

WIREMAN, complete installations, mechanical, technical knowledge.—WHITE, 18, Lower Coombe Street, Croydon. 860

WIREMAN wants job, own casing or Simplex.—Apply, 934, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 934

WIREMAN wants work, casing or Simplex.—"PHILLPOT," 56, Geneva Road, Brixton. 935

WIREMAN (Young), simplex, casing, &c., good references.—"ELECTRIC," 44, Millbrook Road, Brixton. 927

YOUNG Man (age 25), seeks situation, meter fixer.—"C.," 9, Pratt Street, N.W. 902

FOR SALE.

FOR SALE.

20 N.H.P. CROSSLEY'S HIGH SPEED GAS ENFINE (50 B.H.P.) Fitted with all latest improvements. Intake and exhaust silencer and scavenging arrangement. Valves for town's or producer gas. Starter. Worked two seasons.

DYNAMO. Compound wound by Edmondson, 110 volts, 190 amps., 530 revolutions. Three bearings, slide rails, switchboard, measuring instruments, and regulating resistances. Worked three seasons.

TWO 9 N.H.P. CROSSLEY'S GAS ENGINES AND STARTER. Exhaust silencers and scavenging arrangements. Running alternately since end of 1896.

DYNAMO. Compound wound. Crompton's. 115 volts, 127 amps., 1110 revolutions. Three bearings. Slide rails. Switchboard, measuring instruments, regulating resistances. New this year.

BELTS. Double leather, copper stitched, two 10 inch, one 8 inch, one 9 inch, all about 22 feet centres.

All in perfect condition and can be seen working in Newtown.

REASON FOR DISPOSAL:—Having completed central generating station.

Also a quantity of PULLEYS, SHAFTING, and GUARDS.

Apply—

"ENGINES,"
c/o PRYCE JONES, LTD.,
Newtown, Montgomeryshire. 768

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ACCESSORIES Business, making good profits, for sale for about £5 00.—Apply in first instance, personally, to H. ALABASTER, ELECTRICAL REVIEW Office, 4, Ludgate Hill, London. 883

ACID Resisting Asphalte supplied in any quantity and floors laid with same.—W. BRIGGS & SONS, LTD., Asphalte Manufacturers, Dundee.

DYNAMOS, small portable, 10 to 12 volts, never been used, £4 each.—UNITED MOTOR INDUSTRIES, LIMITED, 40, Holborn Viaduct, E.C. 865

FOR SALE.—*Continued.*

ELECTRIC Motors for Sale, direct current, 110-volt; several by Crompton, General Electric Company, Walsall Company, and Electric Construction Company. All in excellent condition, very little used:—

¼-H.P., at £6	½-H.P., £10	1-H.P., £15
1½-H.P., £19	2-H.P., £23	2½-H.P., £26
3½-H.P., £33		

Also "Lundell" Enclosed:—

¼-H.P., £12	1-H.P., £17	2-H.P., £25

—A. VEREY & Co., Dover. 909

FOR Sale.—Absolutely new, never been used, and being removed from a nobleman's mansion simply because larger plant is altogether to be put down, Shunt Wound Dynamo, 25 amperes, 150 volts, by John Turner & Sons, Accumulators, Switchboard, Switches, quantity of Twin House Wire, Electroliers and Brackets, Lamps, Shades, and other accessories.—For particulars and prices apply to CHARLES D. PHILLIPS, Electrical Engineer, Newport, Mon. 138

FOR Sale.—Electric Lighting Plant, nearly new: Crossley modern electric lighting gas engine, 20 B.H.P.; two C. and C. ironclad dynamos, each 8-KW., 850 revolutions, 115 volts.—All in perfect order and now running.—Address "P.," 9, Richmond Terrace, Brighton. 856

FOR Sale.—Dynamos, second-hand; iron shaking barrels; cycle wheel trueing machines, cheap.—"CANNING," Snow Hill, Birmingham. 946

FOR Sale.—5-H.P. Byng Hawkins continuous current motor, 100 to 110 volts 850 revolutions. — MARTIN, Electrician, Kidderminster. 918

FOR Sale.—40 H-brake gas engine, by National Company, and dynamo and switchboard, nearly new, can be seen running. Also 4-H oil engine by Crossley.—Apply, CROXSON, Engineer, Southend-on-Sea. 880

FOR Sale.—The British patent of an improved incandescent safety lamp, ordinary size bulbs. Any voltage and caps. Price £1000. Principals only.—864, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 864

FOR Sale or Hire, high class dynamos, motors, alternators, cable and arc lamps.—PERCY HUDDLESTON & Co., 72, Finsbury Pavement, E.C. 780

FOR Sale or Royalty, novel arc lamp invention, absolutely steady light, simple and cheap to manufacture.—Address 836, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 836

FOR Sale.—Rope-driven electric generating Plant, comprising one 200-I.H.P. horizontal compound condensing engine, with jet condenser, by John Fowler & Co., Leeds, with two 100-KW. single-phase alternating current dynamos, with exciters, by the Electric Construction Corporation, Limited; equal to new.—Apply R. H. LONGBOTHAM & Co., Wakefield. 920

43 GLASS Cells 12" × 11" × 13" deep, in good condition. What offers?—TILKE & SMITH, LTD., Melksham. 921

GAS Engine, 2½-horse, by Tangye, two fly-wheels, tank, piping, &c., £22. Also dynamo, 65 volts 12 amperes, £11.—883, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 883

SALE, cheap, 6-N.H.P. Crossley gas engine, 60 amps., charging dynamo; 330-ampere-hour battery, switchboard, &c.—SMITH, 33, Chapel Street, Southport. 859

ARTICLES WANTED.

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ACCUMULATORS, Second-hand, any type, wanted; also lead peroxide, old copper cable, scrap metals, and every description of metallic dross purchased for cash, town or country.—Write, A. BROWN, 77, Lansdowne Road, Dalston, N.E. 8009

PLATINUM, in any form and quantity, purchased at highest prices by DERBY & Co., 44, Clerkenwell Road, London. 6522

SEND particulars and lowest price of any electrical machinery for sale to the "PUBLISHER," Phillips' Monthly Machinery Register, Newport, Mon. 8885

WANTED.—Combined plant about 10 I.H.P. engine for 100 lbs. steam pressure; dynamo, continuous current 250-volt, moderate speed. — State maker, price and full particulars.—No. 910, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 910

WANTED.—Dynamo wanted, good condition, 65 volts, 50 amperes.—CANNING, Snow Hill, Birmingham. 945

WANTED.—Electric Lamp Tops and Scrap Platinum.—EDEY AND Co., 29, Ludgate Hill, London. 925

WANTED.—Engine and dynamo (direct coupled, Willans or Belliss preferred) about 800 amperes, 110 volts, suitable for 180 lbs. steam pressure.—VERNON & SONS, Brunswick Street, Liverpool. 799

(Continued on next page.)

ALFRED R. STILLER,
Borough Electrical Engineer.

Osborne Street,
Colchester.

988

4, Ludgate Hill, London. 170

(*Continued on next page.*)

ARTICLES WANTED.—*Continued.*

WANTED.—Good second-hand Lathe by good maker 14 or 16" centres by 14—16 feet gap bed.—Reply with full particulars to the ANGLIAN ENGINEERING COMPANY, LIMITED, Stowmarket. 908

WANTED.—New or good Second-hand Combined Engine and Dynamo by good maker, output about 130 KW., with 100 lbs. steam pressure. Send lowest price for cash, and where it may be inspected to 879, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 879

MISCELLANEOUS.

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ACCUMULATOR CHARGING.—C. H. Cathcart & Co., having plant specially adapted for this purpose, charge cells of all sizes promptly, thoroughly and cheaply. Terms on application. Accumulators on hire for temporary lighting, experimental uses, &c.—3, Dorset Buildings, Salisbury Square, Fleet Street, E.C. (Telephone No. 266, Holborn). 7865

MISCELLANEOUS.—*Continued.*

EPSTEIN Accumulator Plates for Storage Batteries are now supplied by the sole licensees and makers, W. O. ROOPER AND ROBINS, Electrical Engineers, Stafford. 80

AGENT wanted by special manufacturer of electrical rheostats of every description.—Please address Messrs. REISS AND KLEMM, Stallschreiberstr, 18, Berlin. 906

CONSULTING Engineer, not now practising, prepares students for the electrical profession. Ages 16 to 20. Large country house, all sports, good society, private plant, workshops, course two years. Premium, including board and residence, £170.—884, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 884

ELECTRICAL Engineer having private plant, takes evening students for practical work.—51, Sinclair Road, Kensington, W. 595

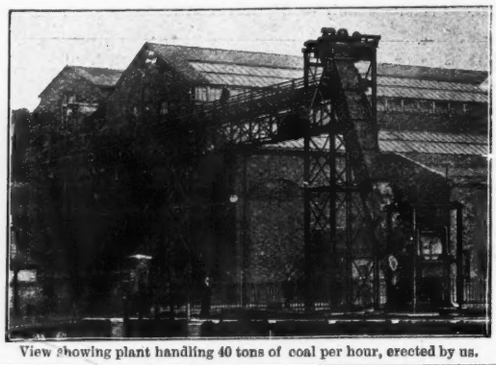
TUITION.—Private evening lessons required at once in the theoretical and mathematical side of the design of alternating current generators and systems of transmission.—Apply, stating terms and other particulars, to No. 902, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 902

WANTED.—Small Works with yard, in neighbourhood of Fulham. Street leading into Fulham Road preferred.—801, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 801

Mr. J. G. LORRAIN M.I.E.E., M.I.M.E. &c.,
Fellow of the Chartered Institute of Patent Agents.
Norfolk House, Norfolk St., London, W.C
"PATENTEE'S HANDBOOK" Post Free on Application. 113

GILBERT ARC LAMP Co., Ltd., CHINGFORD.

GRAHAM, MORTON & CO., Ltd.,
Works: LEEDS.
ELEVATING AND CONVEYING MACHINERY.



View showing plant handling 40 tons of coal per hour, erected by us.

JACKSON-MENSING
ARC LAMPS.
4 SIZES
USED FOR STREET LIGHTING, PROMENADES, FACTORIES, IRON & STEEL WORKS, SHOPS, Public Buildings, Etc. Etc.
USED BY WHITELEYS & FERRANTIS
J-M PATENT
For Prices & Particulars Apply
P. R. JACKSON & CO. Ltd.
Salford Rolling Mills,
MANCHESTER

POPULARLY WRITTEN AND FULLY ILLUSTRATED. PAPER. POST FREE, 1s.

THE STRANGE HISTORY OF A DYNAMO.

By T. E. GATEHOUSE.

Should be read by all interested in the production of electricity. An excellent gift for schoolboys.

H. ALABASTER, GATEHOUSE & CO., 4, Ludgate Hill, London, E.C.

MAGUIRE & BAUCUS,
Standard Electric Railway Supplies,
5, WARWICK COURT, HIGH HOLBORN, LONDON, W.C.

BRIDGEPORT BRASS CO.'S
PHONO-ELECTRIC WIRE.—*The Best Trolley Wire.*
HARD-DRAWN COPPER WIRE.—*High Grade Only.*
COPPER RODS, BARS AND COPPER STRIP IN QUANTITY.

McGUIRE ELECTRIC RAILWAY TRUCKS.
M. & B. ELECTRIC MOTORS.
VITRIFIED TILE CONDUITS.—*Single or Multiple Ducts.*
"ARMORITE" FLEXIBLE STEEL CONDUIT.—*For Interior Construction*
SEND FOR CATALOGUES AND PRICES.

WALKER & HORSFALL

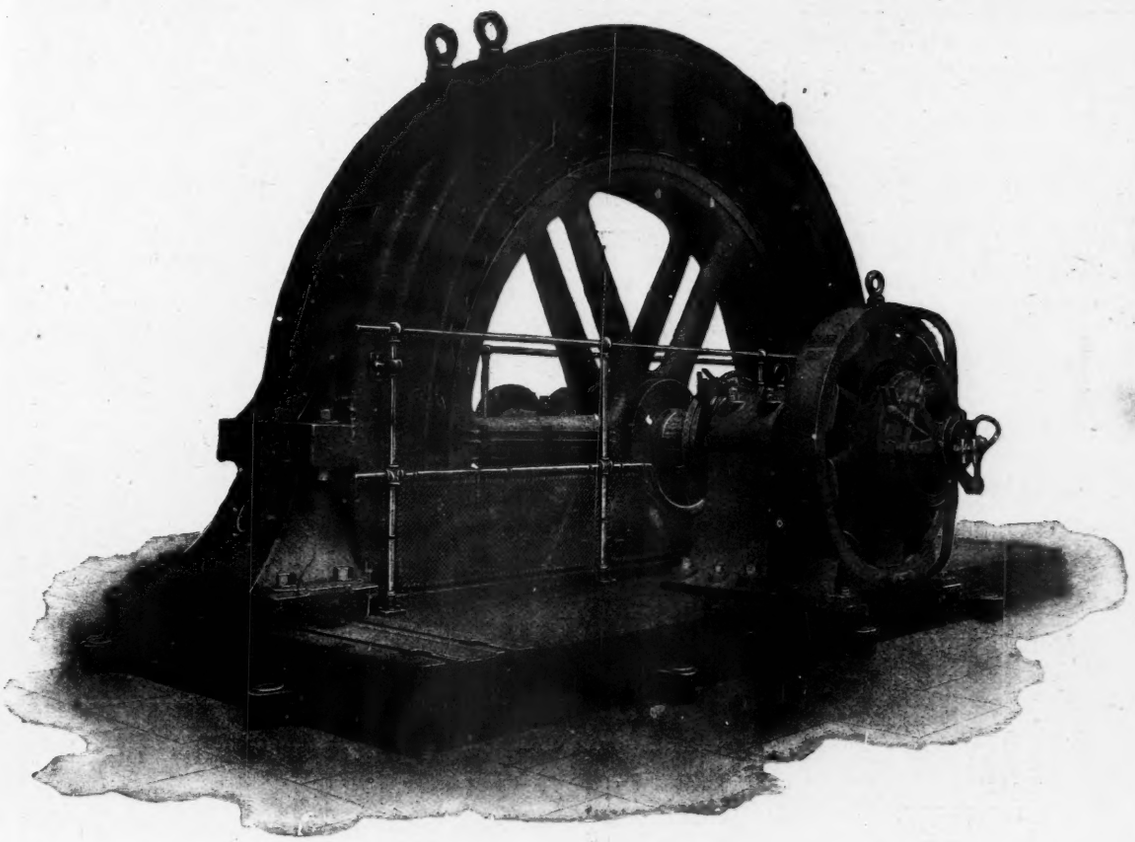
DYNAMOS, small portable, 10 to 12 volts, never been used, £4 each.—UNITED MOTOR INDUSTRIES, LIMITED, 40, Holborn Viaduct, E.C. 885

Liverpool. 796

(Continued on next page.)

LAHMEYER (FRANKFORT)

GENERATORS.



H. M. SALMONY & CO., LTD.,

118–120, CHARING CROSS ROAD

LONDON, W.C.

Telegraphic Address :—"SALMONY, LONDON." Telephone No. 5479 Gerrard.

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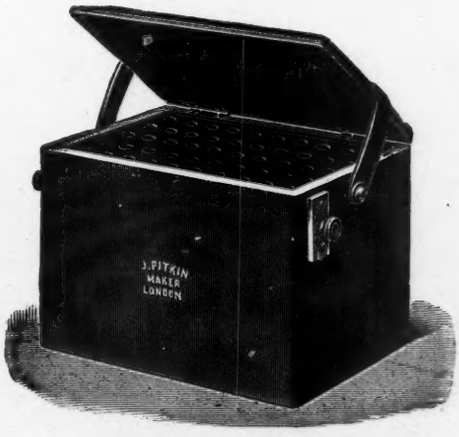

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ELECTRIC HAND LAMPS

Of all descriptions.

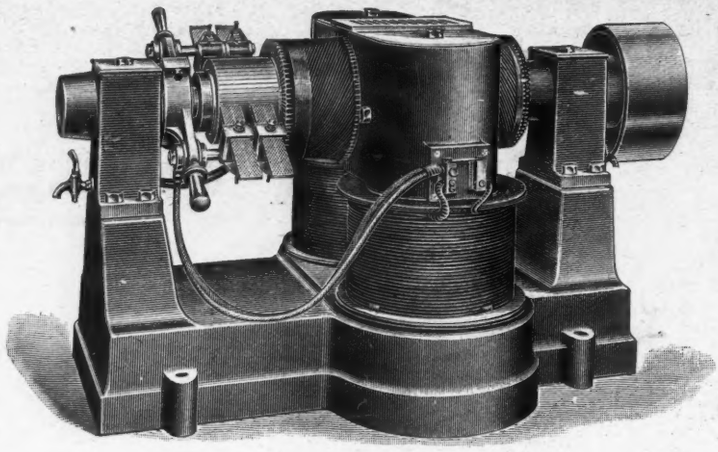
Miners' Electric Lamps.
Portable Batteries.
Surgeon's Batteries.
X-Ray Coil Batteries.
Cyclist Electric Lamps.

PRICE LISTS
PER RETURN.

56, RED LION STREET.
CLERKENWELL, E.C.

Telephone No. 18. ESTABLISHED 1853 Telegrams :—"RICKARD, DERBY."

"ARMORITE" FLEXIBLE STEEL CONDUIT.—*For Interior Construction*
SEND FOR CATALOGUES AND PRICES.



WALKER & HODGETTS,
LIMITED,
ST. SIMON'S ELECTICAL WORKS,
SALFORD.

Our DYNAMOS and MOTORS are fully guaranteed, and have a lot of good features which you should look into before placing your orders

Slotted Armatures with Removable Sections.
Self-Oiling and Self-Aligning Bearings.
No Sparking. Low Temperature Rise.
Highest Efficiency. Large Overload Capacity.

THE CHEAPEST HIGH GRADE MACHINES IN THE MARKET.
WRITE AND GET OUR PRICES. 8645

Telegrams: "Pumping, London."

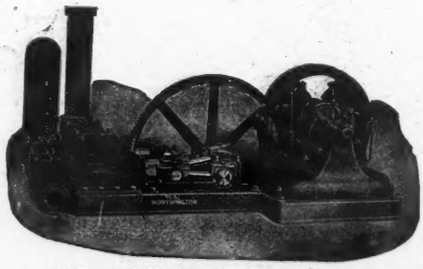
CONDENSING PLANT
Of Every Description and of Any Capacity.

STEAM PUMPS.

WORTHINGTON
TRADE MARK.

Codes Used: A B C., A 1, and Liebers.

Pumps for all Services,
With Simple, Compound, or Triple Expansion Steam Cylinders.



A Type of Worthington Electric Pump.

Telephone No. 614 (Bank).

WATER COOLING TOWERS,
With Forced or Natural Draught.

WATER MOTORS.

WORTHINGTON PUMPING ENGINE CO.
153, Queen Victoria Street,
LONDON, E.C.

NEARLY *150,000 Sold.*

OVER *2500 in Stock.*

CATALOGUES, ESTIMATES, AND PARTICULARS FREE ON APPLICATION.

ENGINES and BOILERS supplied and fixed with all Accessories.
FEED WATER HEATERS, CONDENSERS & COOLING PLANT
STEEL and COPPER STEAM PIPES and Bends, &c.
VALVES and EXPANSION JOINTS, &c.,
SHAFTING, PULLEYS, &c.,
supplied and fixed.
FORGINGS supplied and Machined.

GEORGE WAILES & CO.
ENGINEERS, &C.
Established 1855.
Write for Estimates.

HIGH-SPEED AIR COMPRESSORS, for all Pressures up to 200 lbs. per Square Inch, For AIR BRAKES, MINES, &c., or for Exhausting.

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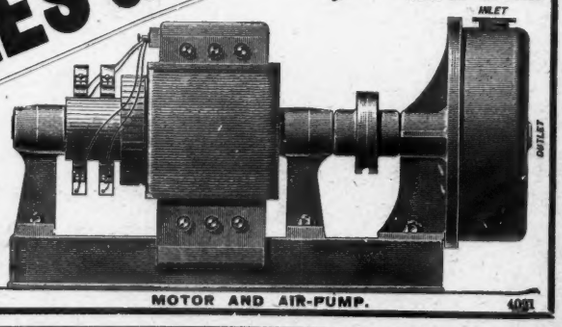


MOTOR AND AIR-PUMP.

PRICE LISTS
PER RETURN.

CLERKENWELL, E.C.

Telephone No. 18. **ESTABLISHED 1853.** *Telegrams:—"RICKARD, DERBY."*

RICKARD'S WIRES AND CABLES ARE USED EVERYWHERE.

AGENTS:

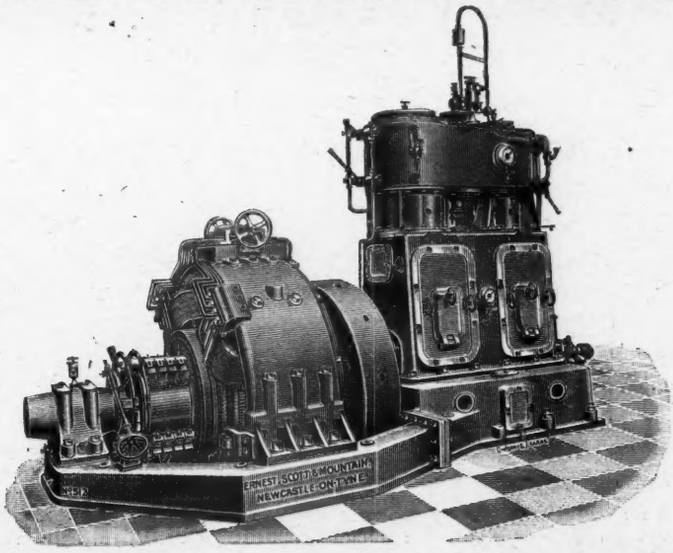
HOLLOWAY & CO., 92, Watling Street, E.C.
MACDONALD & CO., 66, Finsbury Pavement, E.C.
MOORES, FARRELL & CO., 26, Victoria St., Manchester.
A. DILLON, 61, William Street, Dublin.

SCOTT & MOUNTAIN, LTD.,

Electrical and General Engineers, NEWCASTLE-ON-TYNE.

London Office: 20, NEW BRIDGE STREET, BLACKFRIARS, E.C.

Electric Transmission of Power Machinery of all descriptions.



Electric Lighting of all descriptions.

STEAM DYNAMOS.

750 H.P. for Hill of Howth Electric Railway, Dublin.
400 " " Darlington Corporation.
580 " " Birkenhead Corporation.
560 " " Worksop Corporation.
480 " " Worthing Corporation.

SUNBEAM LAMPS.

SUPPLIED TO

ADMIRALTY, WAR OFFICE,
H.M. OFFICE OF WORKS,
GENERAL POST OFFICE,
ALL LEADING ELECTRICAL FIRMS.

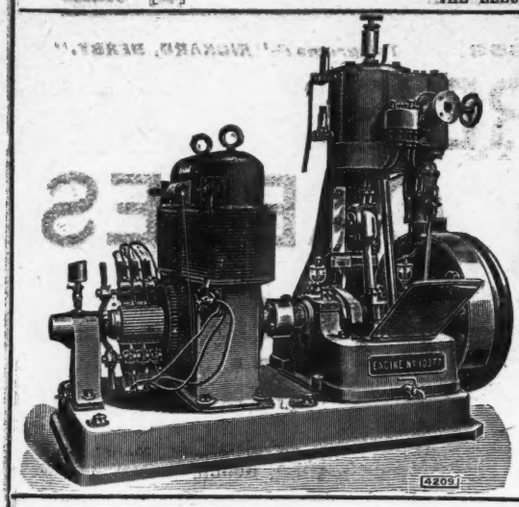
THE SUNBEAM LAMP CO., Ltd.,

141, Fenchurch St., E.C. **Gateshead-on-Tyne.**

Glasgow Office:—168, ARGYLE STREET.

6015

LARGE STOCK



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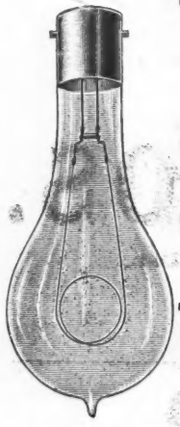

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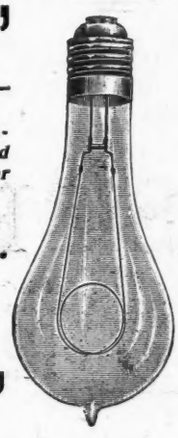

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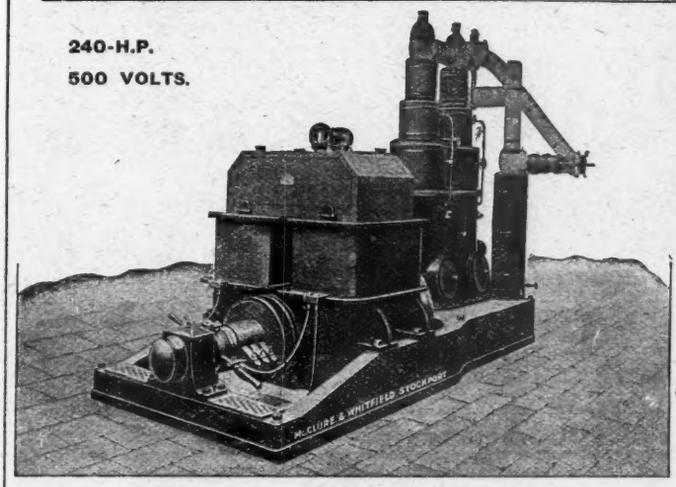

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Kind and Price of Fuel used	"Browney" Steam at 11/3 per ton.	Shildon Lodge (unscreened) at 10/6 per ton.
Mean Temperature of Feed Water	173° F.	209° F.
,, Boiler Pressure	141·6 lbs.	149 lbs. per square inch.
,, Total Coal used lbs.	14,081	13,542
,, ,, ,, per hour lbs.	1,408	1,231
,, ,, ,, per sq. foot of grate per hour	19 98	15·04
Percentage of ash	10·7072 %	10 357 %
Water evaporated at Boiler pressure from Feed Temperature lbs.	*105,100*	*121,530*
,, ,, per lb. coal lbs.	7·461	8·970
,, ,, per hour from and at 213° F. lbs.	11,438	11,654.
,, ,, per lb. coal from and at 212° F. lbs.	*8·116*	*9·462*
Cost of Evaporating 10 tons of Water	13/10	11/1

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Fig. 174.

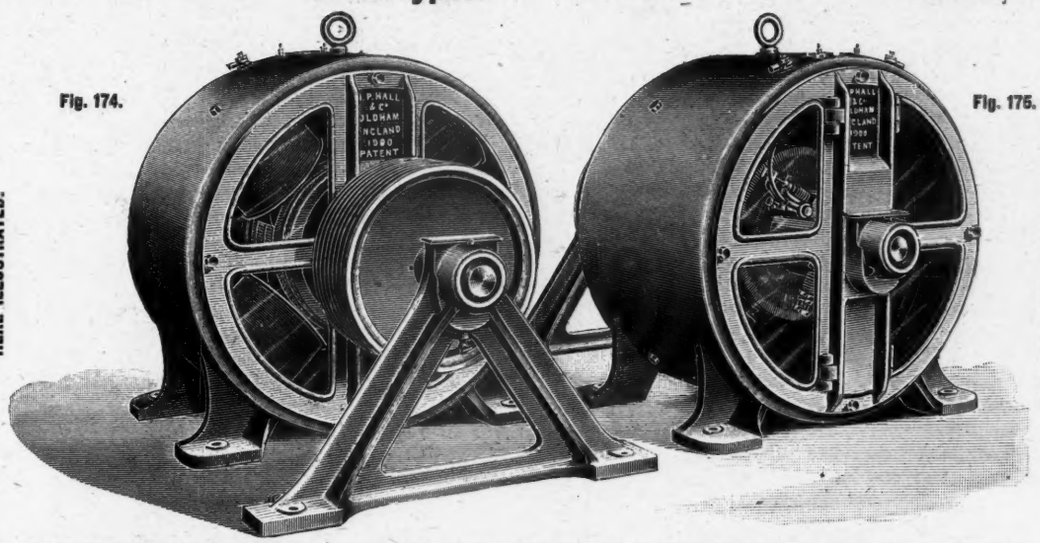

Fig. 175.

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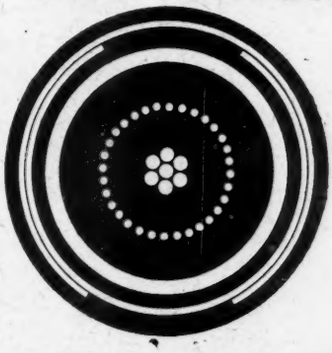

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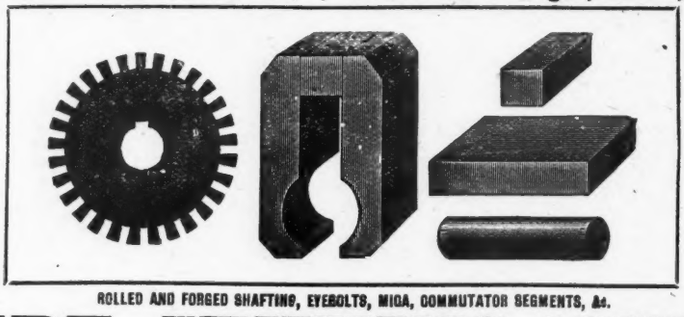

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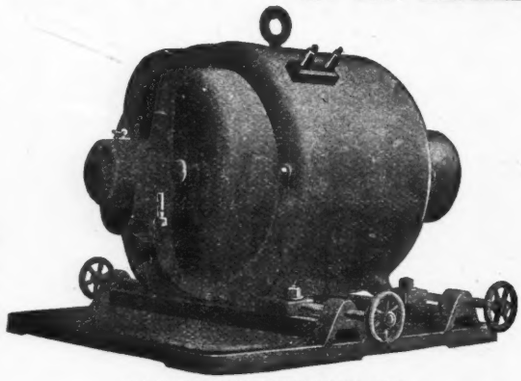

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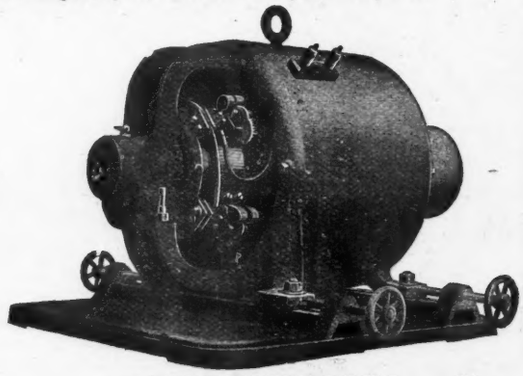

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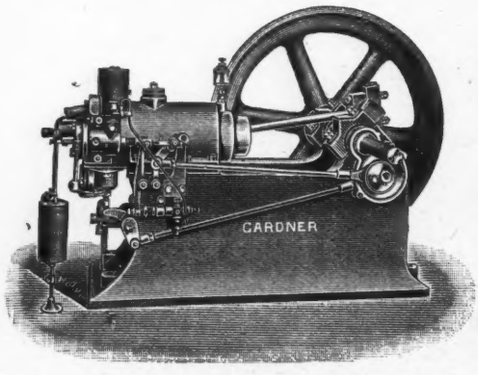

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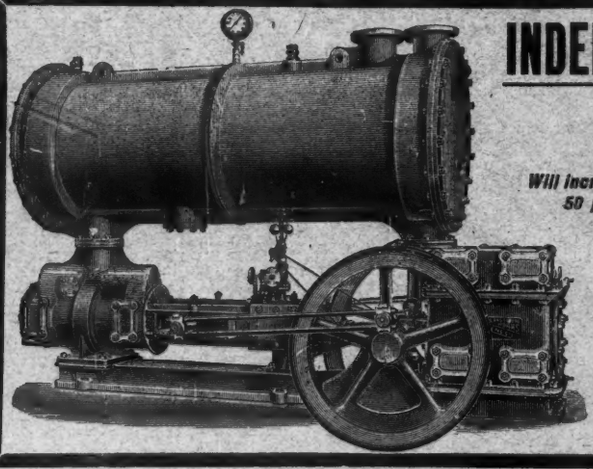

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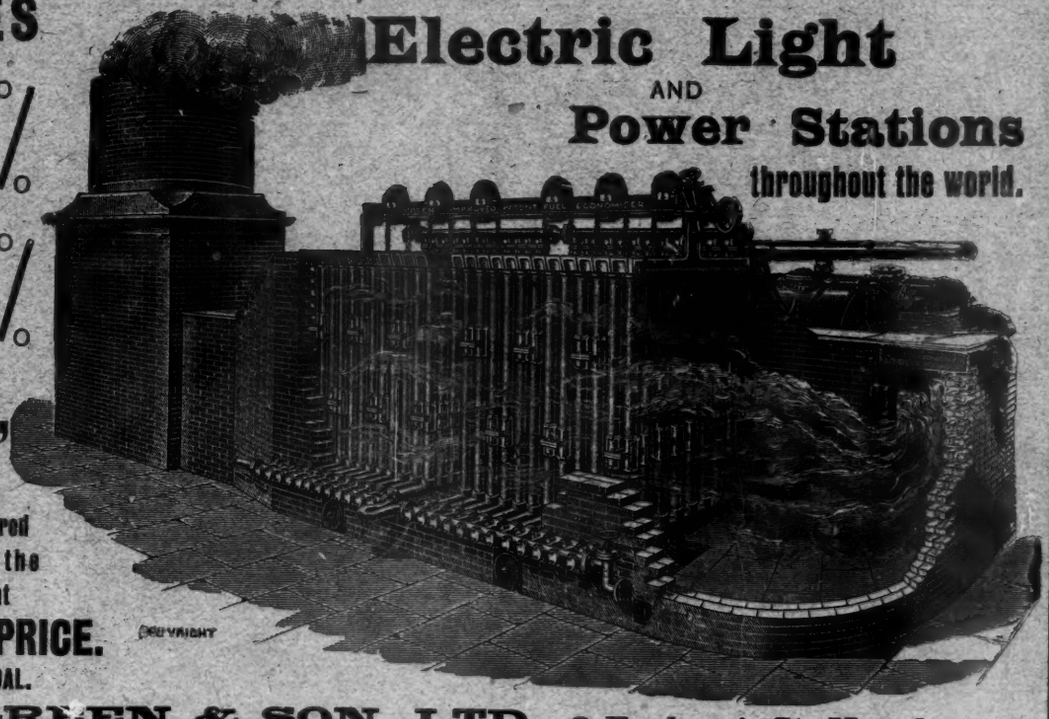

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